NEW MEXICO
SCHOOL
OF
MINES

RIO GRANDE SMELTING WORKS AT SOCORRO.

ANNUAL REGISTER

OF THE

NEW MEXICO
SCHOOL OF MINES

SOCORRO, N. M.

1904-5

WITH ANNOUNCEMENTS FOR 1905-6

SOCORRO
SCHOOL OF MINES PRESS
1905

CALENDAR.

1904–5.

May 25–26—Spring examinations of admission.
September 10–12—Fall examinations of admission.
Monday, September 12—First Semester begins.
Thursday, November 24—Thanksgiving recess.
Friday, December 23—Christmas vacation begins.
Monday, January 2—Work resumed.
January 19–20—Mid-year examinations.
Monday, January 23—Second semester begins.
Monday, May 22—Final examinations begin.
Friday night, May 26—Commencement.
Monday, June 12—Summer term begins.

1905–6.

May 24–25—Examinations of admission.
September 10–12—Fall examinations of admission.
Monday, September 11—First Semester begins.
Thursday, November 30—Thanksgiving recess.
Friday, December 22—Christmas vacation begins.
Monday, January 3—Work resumed.
January 17–19—Mid-year examinations.
Monday, January 20—Second semester begins.
Monday, May 21—Final examinations begin.
Friday night, May 25—Commencement.
Monday, June 11—Summer term begins.

CONTENTS.

FACULTY.

CHARLES ROLLIN KEYES, A. M., PH. D., *President of the School: Professor of Mining Geology.*

B. S., Iowa State University, 1887; A. M., Iowa University, 1890; Ph. D., John Hopkins University, 1892; University Scholar, J. H. U., 1889; Fellow in J. H. U., 1891, Fellow by Courtesy, J. H. U., 1892; Assistant U. S. Geological Survey, 1889–92; Chief Geologist and Paleontologist, Missouri Geological Survey, 1890–2; Assistant State Geologist of Iowa, 1892-4; Director of Bureau of Geology and Mines of Missouri, 1894-1897. Travel in Europe, 1897-8; Consulting Mining Geologist, 1890-1905; Consulting Mining Engineer, Santa Fe Central Railroad Co., 1902-3; Consulting Mining Geologist, New Mexico Fuel and Iron Co., 1902–5.

EMMET ADDIS DRAKE, A. M., *Professor of Languages and of English.*

A. B., Wisconsin University, 1882, A. M., Wisconsin University, 1887; Assistant Engineer, Northern Pacific Railroad Co., 1882-3; Instructor in Rhetoric and Oratory, Wisconsin University, 1883-4; Instructor in Missouri School of Mines, 1884-91; General Manager Columbia Mining Co., 1891-7; Editor of Socorro Chieftain, 1900–3.

OLIVER RUSSELL SMITH, B. S., C. E., *Professor of Civil Engineering.*

B. S., Kansas State Agricultural College, 1898; C. E., New Mexico School of Mines, 1902; Graduate Student, Kansas State Agricultural College, 1898-9; Graduate Student, Kansas State University, 1899-1901; Instructor in Mathematics and Draughting, New Mexico School of Mines, 1900-2; Assistant Surveyor, United States General Land Office, 1902; Assistant Professor of Engineering, Surveying and Draughting, N. M. S. M., 1902; City Engineer of Socorro, 1902-3; United States Deputy Mineral Surveyor, 1903-5.

J. F. ATKINSON, B. L., *Acting Professor of Mathematics.*

B. L., Stevens College, 1892; Graduate Student, 1892-4; Instructor in Mathematics, Knob Noster High School, 1895-6; Graduate Student, Missouri State University, 1896-7; Assistant in Mathematics, N. M. S. M., 1898-1901; Graduate Student, California University, 1900-1; Instructor in Mathematics, N. M. S. M., 1901-2; Assistant Professor, N. M. S. M., 1902-3.

CARL EDWARD MAGNUSSON, B. E. E., M. S., Ph. D., *Professor of Physics and Electrical Engineering.*

B. E. E., Minnesota State University, 1896; Scholar in Physics, Minn. State Univ., 1895-7; Graduate Student, Minn. State Univ., 1896–7; M. S., Minn. State Univ., 1897; Instructor in the Sciences, St. Peter State High School, 1897-8; Graduate Student, Wisconsin State Univ., 1898-1900; Fellow in Physics, Wisconsin State Univ., 1899-1900; Ph. D., Wisconsin State Univ., 1900; Instructor in Physics, St. Cloud High School, 1900-1; Professor of Physics and Mathematics in New Mexico University, 1901-3.

...., *Professor of Mining Engineering and Metallurgy.*

CHARLES HENRY GORDON, A. M., Ph. D., *Professor of Mineralogy and Petrography.*

B. S., Albion College, 1886; Ph. D., Chicago University, 1895; Instructor in Science, Keokuk High School, 1889-7; Principal of Wells School, Keokuk, 1887-90; Instructor in Natural History, Northwestern University, 1890-3; Superintendent of Public Schools, Beloit, 1893-7; Graduate Student, Heidelberg University, 1897-8; Superintendent of Public Schools, Lincoln, Nebraska, 1898-1903; Acting Professor of Mineralogy and Geology, Washington State University, 1903-4.

ROBERT PEELE NOBLE, A. M., *Professor of Chemistry, and Director of the Chemical Laboratories.*

A. B., Du Pauw University, 1891; A. M., Du Pauw University, 1894; Graduate Student Johns Hopkins University, 1891-2; Principal Crawsfordsville High School, 1892-96; Graduate Student, Chicago University, 1897-8; Professor of Chemistry; Vincennes University, 1898-1901; Assistant Professor of Chemistry, Armour Institute of Technology, 1901-4.

BOLLING HALL CRENSHAW, B. S., M. E., *Professor of Mechanical Engineering.*

B. S., Alabama Polytechnic Institute, 1889; M. E., same, 1890; Civil Engineering, 1890-1; Graduate Student, Cornell University, 1891-2; Instructor in Mechanical Engineering, Alabama Polytechnic Institute, 1892-6; Associate Professor in Mathematics, same, 1896-1904.

.............................., *Professor of Machine Design and Draughting.*

DELL FRANK RIDDELL, Ph. C., B. S., E. M., *Acting Professor of Assaying.*

Ph. C., Chicago College of Pharmacy, 1896; B. S., Nebraska State University, 1901; E. M., New Mexico School of Mines, 1905; Professor of Chemistry, Sioux Falls College, 1901-03; Instructor in Chemistry, New Mexico School of Mines, 1903-4.

.... *Librarian.*

R. H. BERRY.................................. *Registrar.*

M. P. HUNTER................................ *Mechanician.*

New Mexico School of Mines.

HISTORICAL SKETCH.

The New Mexico School of Mines is an institution founded by act of the legislature of 1889. Under a subsequent act of Legislature, approved February 28, 1891, a board of trustees was appointed and an organization effected. Immediate steps were taken towards the erection of necessary buildings. Plans and specifications were drawn by Messrs. Thayer and Robinson, architects of New York City, representing the most modern requirements developed by the experience of the leading technological institutions of the country.

Early in 1892, a Circular of Information, regarding the New Mexico School of Mines, at Socorro, New Mexico, was issued by the Board of Trustees. In this circular the aims of the school were fully set forth. The following year a president was chosen and students in chemistry were admitted; but it was not until the autumn of 1895 that the Mining School was really opened.

The Legislative act creating it provides that the School of Mines shall be supported by an annual tax of one-fifth of a on all taxable property. This levy was increased by the Legislature in 1899 to twenty-seven and one-half one-hundredths of a mill. The 34th General Assembly, in 1901, recognized the growing importance of the School by further increasing the tax levy to thirty-three one-hundredths of a mill. In 1903, the 35th General Assembly raised the millage to forty-five one-hundredths of a mill. This, with greatly increased assessed valuation of property doubled the income of the School over that of the previous year.

In 1891, a special appropriation of $4,000 was made for the partial equipment of the Chemical and Metallurgical Laboratories; and in 1893 another special appropriation of $31,420 was was made, to enable the School of Mines to be organized in accordance with the policy outlined by the act creating the institution.

By Act of Congress, approved June 21, 1893, the New Mexico School of Mines received for its share of certain grants of land, fifty thousand acres for its support and maintenance.

This liberal and valuable grant of land in a part of the country which is being rapidly opened up by eastern capital will soon place

the institution on a strong finacial basis. In this respect the income derived will eventually put the School of Mines of New Mexico on the same footing as other leading schools of technology in the country.

Already valuable aid is beginning to flow towards the School through this newly opened channel. Three years ago a fund of over $13,000 was realized from certain portions of these lands. A year later a somewhat smaller sum was made available. During the past year the income from this source was nearly $10,000. The 34th Legislative Assembly authorized the bonding of any portion of this grant of lands, in order more thoroughly to equip the School with buildings and apparatus for the proper execution of its growing needs.

STATUTES RELATING TO THE SCHOOL.

Some of the sections of the Act creating the School of Mines are as follows:

The object of the School of Mines created, established and located by this Act is to furnish facilities for the education of such persons as may desire to receive instruction in Chemistry, Metallurgy, Mineralogy, Geology, Mining, Milling, Engineering, Mathematics, Mechanics, Drawing, the fundamental laws of the United States and the rights and duties of citizenship, and such other courses of study, not including Agriculture, as may be prescribed by the Board of Trustees.

The management and control of said School of Mines, the care and preservation of all property of which it shall become possessed, the erection and construction of all buildings necessary for its use, and the disbursement and expenditure of all moneys appropriated by this Act, or which shall otherwise come into its possession shall be vested in a board of five trustees, who shall be qualified voters and owners of real estate; and trustees shall possess the same qualifications, shall be appointed in the same way, and their terms of office shall be the same, vacancies shall be filled in like manner, as is provided in Sections 9 and 10 of this act. Said trustees and their successors in office shall constitute a body corporate under the name and style of "The Trustees of the New Mexico School of Mines," with right as such of suing and being sued, of contracting and being contracted with, of making and using a common seal and altering the same at pleasure, and of causing all things to be done necessary to carry out the provisions of this Act. A majority of the board shall constitute a quorum for the transaction of business, but a less number may adjourn from time to time.

The immediate government of their several departments shall be intrusted to the several faculties.

The board of trustees shall have power to confer such degrees and grant such diplomas as are usually conferred and granted by other similar schools.

The trustees shall have power to remove any officer, tutor or instructor or employee connected with said school when in their judgment the best interests of said school require it.

The board of trustees shall require such compensation for all assays, analyses, mill-tests, or other services performed by said institution as they may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines for said institution, and an accurate account thereof shall be kept in a book provided for that purpose.

ORGANIZATION.

The New Mexico School of Mines is composed of three separate divisions: the School of Mines proper, the College, the Academy.

The School of Mines. The primal division of the Institution is essentially for professional and graduate work. Its plan of close articulation with the College is fully explained elsewhere. The relationships to the Technological Schools are also made clear in another place.

The College. The work leading up to the Baccalaureate degree is offered not only in connection with that of the professional engineering and technological training, but it is open to all students, particularly those from New Mexico who are looking forward to a liberal education independently of its relations to professional careers.

The Academy. A recent legislative act made it obligatory upon the higher educational institutions in New Mexico to maintain temporarily a preparatory department, in order to better supplement the work of public schools. With this end in view the School of Mines has affiliations with the Socorro High School.

LOCATION.

The New Mexico School of Mines is located at Socorro, the capital of Socorro County, in the central part of the commonwealth. The location is on the main line of the Atchison, Topeka and Santa Fe railroad, 75 miles south of Albuquerque, and 180 miles north of El Paso. The Magdalena branch of the Santa Fe railway starts from this place.

Socorro is a city of about 4,000 inhabitants. It is pleasantly

situated in the broad fertile valley of the Rio Grande, at the foot of the Socorro range of mountains. The altitude of the town is about 4,600 feet above the sea. The location is pre-eminently pleasant and healthful. The city has long been attractive to health-seekers who wish a mild, dry and invigorating climate, and many persons every year have sought its hospitalities. It is one of the ideal residence places of the region. The scenery is quite diversified by plains, broad valley slopes, mesas, varied hill country and lofty mountains. In the city are two hotels, a number of good boarding houses, several large public school buildings, and a court house, recently completed at a cost of $50,000. The churches represented are the Presbyterian, Roman Catholic, Episcopal and Methodist.

Socorro has one of the best systems of public water supply in the country. The water is very soft and pure, and is furnished by hot springs which, four miles away, issue from the Socorro mountains. Two newspapers are published. There is here a fine modern artificial ice plant, a large roller-process flouring-mill, a smelter covering 20 acres, an extensive clay-manufacturing plant, where are made fire brick, building brick, tiling, sewer-pipe and all kinds of ware requiring a fine grade of fire-clay.

A large number of mines of all kinds, smelters, irrigation systems and other engineering works, are easily accessible to the School. Within a few hours' ride by rail, are many important mining camps. The longer excursions bring the student to some of the most famous mines in southwestern United States. Some of the longest worked lodes in America are in this region. For more than 350 years they have yielded their wealth to the European and centuries before his advent gave up even greater treasures to the native races.

The surrounding country is rich in illustrations of geological formations and structures. The characteristic scenery of the Rocky Mountains is well represented in this region of New Mexico. To the west is the Great Elevated Plateau region with the isolated, majestic volcanic groups rising abruptly, thousands of feet above the surrounding plains. The Grand Canyon of the Colorado is reached on the longer annual geological excursions. Altogether, no locality in the whole world affords so abundant opportunities for practical instruction and profitable study.

PURPOSES OF THE MINING SCHOOL.

The ideal to which the New Mexico School of Mines tenaciously holds is the practical directing of young men to take active part

in the development of the mineral wealth of our country and the world.

The New Mexico School of Mines is a state institution. It was established primarily to promote mining and mining interests in southwestern United States. However, it has a much wider scope. It is intended to provide adequate facilities for the thorough training of men in the ways of modern mining. The purpose is to meet the demands for a mining education, (1) by young men who are residents of New Mexico, (2) by men living in the Great Southwest, and (3) by students from other parts of the country and world desiring to avail themselves of the peculiar advantages of this region.

During the past quarter of a century the development of the mineral wealth of the Nation has been phenomenal. Of late the call for adequately prepared young men to direct mining enterprises in all their various ramifications has been unprecedented. The mining schools located in the chief mining regions have been taxed beyond their capacities,and have been obliged to turn away students.

As a technical institution, the field of a school of mines is commonly considered to be outside that of ordinary college and university instruction. In the case of the New Mexico School, location has made it necessary to trespass somewhat upon both the other fields of modern higher education. On account of the unexcelled natural surroundings for original research work concerning problems relating directly to mining and geology, provision for advanced work is made by the School. It is not believed that the best results are secured by shutting out the humanities from the technical school. There is offered therefore, instruction in the most important of these branches, a knowledge of which goes to make up a liberal education. All students who are not already college graduates are encouraged in every way to take up as much as possible of the broader work.

In the training offered by the School there is noteworthy concentration of effort. There are many advantages in the direction of effort along few lines. In contrast with the many diversions that necessarily exist in most technical institutions of learning, where all practical branches are equally represented, singleness of purpose is a leading feature in the New Mexico School of Mines. The student body in all its parts becomes immensely more sympathetic. The workings are more perfectly harmonious. Instruction is more advantageously given.

Several features contribute to the success of this institution as

a school of mines. The unique natural surroundings of the School create an invigorating mining atmosphere which is entirely wanting in situations away from the mines and mountains. The conservation of energy growing out of the special methods of instruction happily adapts the student so that he gets the most out of his efforts. The broad practical experience in fields outside of the School forms an integral part of the training in mining engineering. The encouragement for advanced and original work is such as is seldom offered by purely technical institutions. Moreover, at all times the student is made to feel that he is a part of the school organization and that his success is one of the best proofs of the School's success.

If we look into the history of modern mining schools and universities, we find that each becomes most celebrated along the line for which its locality is best known on account of its natural surroundings. Few institutions of learning are more dependent for success upon what may be called the accident of geographical location than the mining school. It may be truthfully said that no mining school is more fortunately situated so far as natural environment is concerned than that of New Mexico.

The New Mexico School of Mines enjoys the natural advantage of being located in the midst of a region peculiarly rich in minerals of nearly all kinds, and is within easy reach of the most varied geological conditions, all of which are within a radius of a score of miles of Socorro. Almost the entire geological column from the precious metal-bearing formations of the Archean to the coal beds of the Tertiary is here exposed. The industrial processes connected with mining and metallurgy may be seen admirably illustrated at Magdalena, Kelly, Rosedale, San Pedro, Hillsboro, Cook's Peak, Silver City, Pinos Altos, Los Cerillos, Gallup, Carthage, and elsewhere within easy reach of the School. These illustrate the most modern methods of mining, milling, ore-dressing, concentrating, smelting, lixiviation, chlorination, etc., as well as the native Mexican methods, which are worthy of careful study, since the like cannot be seen elsewhere in the United States.

The grounds immediately adjacent to the School of Mines include irrigable land, plateaus and mountain formations, all affording an excellent field for practice in surveying, the laying out of railroads and irrigating canals, topography, mine engineering and geology, so that students can be prepared at the very doors of the School in those branches which usually require tedious excursions from most other schools.

New Mexico, so far as concerns the mountainous portion, which comprises nearly two-thirds of its area and is nearly all mineral-

bearing, is perhaps less known geologically than any other section of the United States. A little study of the plateau region of the northwestern portion of the territory has been made by the United States Geological Sunrvey, but only in a general way. No attempt has ever been made, under government auspices, to investigate closely the geological structure of New Mexico mountains such as has been carried out in the other Rocky Mountain states, or to study the conditions of New Mexican mineral deposits, as has been done in Colorado by Emmons, in Nevada by Curtis, in California by Becker, and in other states by other distinguished investigators.

The field for original scientific research in New Mexico is unrivaled by any other mining region and the opportunities here offered are not neglected in the plan and scope of instruction.

It is proposed that much of the advanced professional work of the school shall be of an original nature, to the end that the graduates may be skilled, theoretically and practically, in the very problems which they, as professional men, will be called upon to solve. In connection with this work, it is hoped to enlist every chemist, geologist, mining engineer, metallurgist and other scientific investigator capable of observing and recording professional experience in the region. This work will be carried on by the advanced students, under the direction of the professors, and will involve the collection of notes, sketches, maps and specimens, and the results of directed observation in all matters relating to the sciences and arts embraced in the courses of study. The results of these observations, together with illustrations and analyses, will be printed from time to time in the scientific press, or in the special publications issued by the School. While this plan of instruction will furnish material for practical and original research on the part of the advanced students, it is believed that it will also be of great practical utility to the industries of the Southwest, and that in an important sense the School will have for its students not only those who may study within its walls, but also the greater part of the educated mining population of the region.

The subjects for such researches in geology and mining, and in the reduction of the ores of lead, silver, gold and copper are so numerous that it is impossible to attempt to do more here than to mention the fact that the conditions of climate, drainage, water-supply and geological structure in New Mexico differ greatly from the conditions existing in other parts of the Rocky Mountains, giving rise to new problems in practice. These problems are not by any means all that deserve attention. The investigation of the ores

of iron, manganese, aluminum, cobalt, nickel, tin and quick-silver, together with the beds of coal, salt, alums, building-stones, mineral-paints, cement-rocks, marls, etc., etc., will be directly in the line of the advanced laboratory work of the School, and every student who undertakes such work will be encouraged in every possible way to accomplish the best results.

During the last year of his course every candidate for graduation is required to make a thoroughly scientific investigation of some subject connected with his course of study and to embrace his results in a thesis, which is subsequently published.

These advantages which may be constantly made use of thus become essentially a part of the School's equipment. To the greater part the student not only has access, but he is required as an integral part of his course, to visit and critically inspect, under the direct supervision of his instructors the various plants and works, and to make intelligent reports. Being obliged from the start to make the most of the exceptional opportunities presented, he quickly falls into the spirit of his present and future work, and at once necessarily acquires for his chosen profession a sympathy that is seldom attained except after school days are over and after long and strenuous effort.

Contact with practical and successful men week after week is a complete technical education in itself, even if it were not an essential part of a systematic course. The student receives an inspiration for productive work that is rarely otherwise acquired. His faculties of observation are sharpened. He has hopes well grounded for grand achievements. Everywhere he is able to find the most forceful illustrations of the abstract principles that are presented to him. In the practical courses he is continually reminded of the commercial bearings of his efforts. In the more purely scientific courses he is continually brought face to face with the specific bearings of his observations upon the universal problems. The lecture room, the laboratory, the field, all are equally necessary in a technical and scientific education.

REQUIREMENTS FOR ADMISSION.

The main requirement for matriculation in the New Mexico School of Mines is a satisfactory demonstration that the candidate is amply prepared to profitably carry on the courses which he desires to select. Perusal of the outlines of courses offered soon gives an adequate idea of what is necessary in each case. Formal examinations may be held. The necessary preparation is afforded

by the training received in the best high schools of the country. The ordinary requirements for entrance to colleges of acknowledged standing admit also to this institution. Special attention is called to the mathematics. Thorough preparation is of prime importance, in order that the student may secure the full benefits of his studies. In the School of Mines the time of the student is fully occupied. There is little time to make up deficiencies.

Admission to advanced standing is based upon similar grounds. In case the demonstration of fitness to undertake advanced work is not satisfactory, examinations may be given in any or all subjects below those in the courses to be pursued. Undergraduates of other colleges may receive credits for the work already done, so far as it can be made equivalent to that required in this institution, in the courses specified. The applicant's knowledge of mathematics will determine his class rank, conditions being allowed in other subjects. College graduates intending to take up professional courses will be admitted as regular students of advanced standing, and, at first, credits will be given provisionally for work already done along the lines of the professional courses.

In several of the departments of study, the opportunities afforded by New Mexico for college graduates to undertake original investigations and follow special lines of work are so exceptional that the School encourages efforts of this kind in every way possible. Whether or not the student intends to become a candidate for the higher academic degrees in this or other institutions, the same care will be taken to give him every facility to further his work.

Admission as a student in the special courses offered has only a single test in each case—that of furnishing satisfactory evidence that the applicant is qualified to follow the chosen course.

Teachers and persons of mature age engaged in technical pursuits are offered every opportunity of the lecture-room and the laboratory.

PREPARARORY WORK.

As an integral part of its regular work, the School of Mines cannot guarantee to undertake to furnish all the necessary instruction to students desiring to attend the School but who have not met all the requirements for admission to the regular college courses. Provision is made for a certain amount of this preparatory work; but the extent to which this may be done is necessarily quite limited. Moreover, the maximum limit of preparatory studies permitted to be carried on in the School varies with the individual, his previous training, his aims, and his capacity to undertake extra work.

Even if the School felt under obligations to give full preparatory instruction it would be physically unable to do more than a limited amount, unless its present faculty be largely increased.

It cannot be urged too strongly that students expecting to matriculate with this institution come prepared to take up the work without conditions. Every candidate for admission to the School may rest assured that after entrance his time will be very fully occupied.

COURSES OF INSTRUCTION.

The School offers regular courses of study in the following:

1. Mining Engineering.
2. Metallurgy.
3. Mining Geology.
4. Civil Engineering.
5. Chemical Engineering.
6. Electrical Engineering.
7. Liberal Arts.

Each course covers four years (including summers except the last mentioned.) During the first year the studies are nearly identical for all courses; but after that they rapidly diverge.

These courses lead up to the degrees of—

Bachelor of Arts, A. B.

Mining Engineer, E. M.

Civil Engineer, C. E.

It is expected that the entrance requirements will be somewhat more than those for ordinary college admission, so that the student virtually enters the second college year. Upon the satisfactory completion of the regular course at the end of three years the bachelor's degree is conferred; and at the end of the year following—the fourth year—the engineer's degree is given. The summer work taken in connection with the work of the regular school year develops rather more than the usual requirements of technical schools and colleges.

In the courses of Chemistry and Metallurgy, and of the Mining Geology, excellent opportunities are offered for advanced work extending over three years beyond that offered in the regular college work.

In addition to the four regular courses scheduled, several special courses are offered to meet the demands made by persons of mature age and more or less practical experience in mining.

The special courses offered during the ensuing year are:

1. Assaying.
2. Mine Surveying.
3. Land Surveying.
4. Prospecting.
5. Practical Mineralogy.
6. Geology of Ore Deposits.

MINING ENGINEERING.

The course in mining engineering aims to so symmetrically develop and train the student that he may be able to enter at once into the spirit of a mining enterprise; formulate complete plans for it, and see that the entire work is carried successfully to completion. The selection and articulation of the various studies are believed to be such as to properly adjust them to the main theme. It is believed that very nearly the due proportions of time are given to th theoretical aspects of the subject, laboratory demonstrations, field practice, and actual work in and about the mines.

The several departments of the School are drawn upon, each according to its relative importance in mining operations. The courses of study offered by each department are quite complete as a connected and dependent sequence on a given subject. But in the schedule for mining engineering, for example, only certain courses in each department are essential, as bearing directly upon the mining profession. The laws and principles laid down by Mathematics, Mechanics, and Physics, form the foundation upon which the superstructure of the professional training is built. The natural sciences of Mineralogy, Geology, Chemistry, Metallurgy and Biology furnish indispensable data. Mechanical, civil, and electrical engineering subjects contribute largely to a complete mining course. Business capacity and a knowledge of men are necessary to a successful career in mining engineering.

During the entire period of his training the fact is impressed upon the student that intelligent mining is strictly a business operation that mining is today as capable of being put on a secure business foundation as any manufacturing enterprise; that from start to finish it is a proposition akin to all the great business workings, such as enable the railroad train or the ocean liner to run with certainty and dispatch; that while "lucky finds" will continue to be made, mining as a business is no longer a vast lottery, ever developing to their fullest extent the gambling propensities of mankind.

By constant association with men entirely engaged in the mining industry the student is soon introduced to the practical features of his training, and long before he has finished his training at school, he will have acquired, from actual experience, a rather broad knowledge of the requirements and opportunities of the mining engineer.

The exceptionally favorable environment of the School being such as to fit it to a pre-eminent degree for a mining institution, special stress is laid upon the value of practical work in the mines and about the smelters. To this end the summer practice is emphasized. The student goes into the mines and becomes thoroughly familiar with their operation, the problems coming up for solution, and the special mechanical devices which have been built to meet the local difficulties. In order to make this work particularly impressive and valuable, arrangements are made with mine operators and managers whereby remunerative employment is given for a longer or shorter period to such students. It is expected that arrangements may be effected by means of which provision may be made for all students who wish to avail themselves of these exceptional opportunities.

METALLURGICAL ENGINEERING.

The engineering feature permeates all of the work of the metallurgical engineering course. In the general plan the wide practical experience of a large number of managers and superintendents of plants in the metallurgical industries has been taken into account and the work arranged with a view of overcoming as much as possible many of the defects in the commercial training of technical men. The oft repeated assertion that chemical manufacturers prefer a good engineer with no knowledge of chemistry to a good chemist with no knowledge of engineering is not so much gross exaggeration as most of us are apt to believe. The engineering bearing of every aspect of the work in this course is emphasized.

Another practical feature of this course is the research work insisted upon. The solution of practical problems is given a prominent place. The student, in his third year, is first required to repeat several pieces of investigation and to suggest any improvements that may occur to him. In his fourth year he is given actual problems that have not been worked out. From his various efforts he may choose one for his thesis, developing the whole subject and treating it exhaustively.

Students showing a special aptitude for research work are fur-

ther encouraged by being assigned to work on the problems constantly being submitted to the officers of the School by mine operators and managers. Except when the problem is manifestly too intricate and difficult, this work is carried on under the immediate direction of the School, and with the assistance of the mine superintendent. As a rule these problems are satisfactorily treated and often important results obtained.

MINING GEOLOGY.

A third branch of mining engineering which has grown up during recent years is rapidly acquiring more and more importance. This is what may be included under the title of Mining Geology, or Geology of Mineral Deposits. The important fact developed during the past decade among mining men is that a mining enterprise to be most successfully carried out is dependent as much upon the proper knowledge of the geological structure and nature of the district as it is upon the construction of the most carefully planned equipment.

In following out this branch, a divergence from the regular engineering course begins early in the second year. A considerable knowledge of practical geology is necessary, and of the methods of field work and the principles underlying independent investigations. Besides the subjects acquired up to this time in mining engineering, a good knowledge of mineralogy, and an ability to use the petrographical microscope are desirable.

In the field work required up to the second year special effort is made to put the student into contact with geological features with which he is afterwards most likely to meet in studying mineral deposits, their genesis, structure and geological relations. He is then called upon to repeat some piece of good work; and is afterwards put upon original investigation. In many cases the latter is, as in the metallurgical courses, often suggested by problems submitted by mining companies. Moreover, the companies often employ members of the School for just this work, in which case the student is doubly repaid.

The thesis must show special merit along geological and strictly engineering lines; and must be published. New Mexico has a large number of problems, suitable for this kind of work, which are now awaiting solution.

CIVIL ENGINEERING.

For the first year all the engineering courses are essentially the same. In the second year these begin to diverge until in the fourth year there is scarcely any study in common.

What has been said regarding the aims, methods and opportunities of the course offered in this institution in mining engineering is largely true also of the course in civil engineering. The chief field practice is intended to be secured during the summer months. Besides the surveying usually taken up, special work is done in locating mining claims, railroad lines in mountainous regions, and in municipal engineering.

Mountainous regions offer so many problems not ordinarily met with that particular effort is made to acquaint the student with the details of as large a number as possible of engineering enterprises of this class.

The situation of New Mexico naturally gives unusual opportunities in land subdivision after the regulations of the United States Land Office, in irrigation work, and in making surveys of mining claims preliminary to securing the United States patents. Students have been able to attach themselves during the summer or a larger part of the year to regular survey parties receiving the compensation usually allowed for this work. It is expected that these arrangements will continue indefinitely.

The advanced topographic work in connection with the Geological Survey is exceptionally instructive, and of such a character that is usually not open to the student of engineering. Special attention is given to the earth's physiognomy as dependent upon the rock-structure and rock-composition underneath; and to the manner in which both should be taken into account in engineering projects. The region round about Socorro has been subdivided into squares containing about 25 square miles each. One of these squares is assigned to each student for surveying and mapping, and for studying it in all its different aspects. By further effort the student may offer this work for a thesis.

COLLEGE OF LIBERAL ARTS.

The regular courses embrace all those studies, except Greek, ordinarily covered by college work. Special effort is made to make the grounding in science thorough. While primarily organized for citizens of New Mexico who desire a liberal and practical education as a preparation for business careers independent of technical or professional training, the college aims to meet all the general demands of the modern commercial activity.

In the languages, emphasis is laid on the modern rather than the ancient. And among these courses a practical speaking acquaintance with the Spanish language is made much of for the reason that in the commercial and mining world one familiar

with the Spanish and English is able to travel with ease through the length and breadth of the three Americas.

The industrial phases of the sciences come in for broad treatment. Specialization along at least one branch of science is insisted upon.

In all the work of the college courses there are kept constantly in the foreground the various fundamental elements of success demanded by modern industrial conditions. But these courses are widely elective so as to permit every kind of mind to develop to its fullest extent. The time required to complete the college course is made a secondary consideration; the amount and character of the work done is made of primary importance. The courses are made sufficiently flexible for a properly prepared and sufficiently matured student to finish in three years; for the majority of students the time necessary is four years. Those students looking forward to professional careers may so plan their work to complete the college course in three years; while those desiring purely cultural training are encouraged to devote four years to the work.

SCHEDULE OF STUDIES.

		Mining Engineering	Civil Engineering.	Metallurgy.	Mining Geology.
FIRST YEAR	FIRST SEMESTER	Trigonometry Descriptive Geometry Inorganic Chemistry Mineralogy Mechanical Drawing Spanish, German or French English	Trigonometry Descriptive Geometry Inorganic Chemistry Mineralogy Mechanical Drawing Spanish, German or French English	Trigonometry Descriptive Geometry Inorganic Chemistry Mineralogy Mechanical Drawing Spanish, German or French English	Trigonometry Descriptive Geometry Inorganic Chemistry Mineralogy Mechanical Drawing Spanish, German or French English
	SECOND SEMESTER	Analytic Geometry Qualitative Analysis Descriptive Geometry Surveying Descriptive Mineralogy Mechanical Drawing Plotting Surveys Spanish, German or French English	Analytic Geometry Qualitative Analysis Descriptive Geometry Surveying Descriptive Mineralogy Mechanical Drawing Plotting Surveys Spanish, German or French English	Analytic Geometry Qualitative Analysis General Metallurgy Surveying Mechanical Drawing Descriptive Mineralogy Mineralogical Laboratory Spanish, German or French English	Analytic Geometry Qualitative Analysis General Metallurgy Surveying Mechanical Drawing Descriptive Mineralogy Mineralogical Laboratory Spanish, German or French English
	SUMMER	Surveying	Surveying	Surveying	Surveying
SECOND YEAR	FIRST SEMESTER	Differential Calculus Quantitative Analysis General Physics Mining Physical Measurements Topographical Drawing Spanish, German or French English	Differential Calculus Quantitative Analysis General Physics Railroad Surveying Physical Measurements Topographical Drawing Spanish, German or French English	Differential Calculus Metallurgy of Lead General Physics Quantitative Analysis Physical Measurements Principles of Geology Spanish, German or French English	Petrography Quantitative Analysis General Physics Mining Physical Measurements Principles of Geology Spanish, German or French English

SCHEDULE OF STUDIES—Continued.

		Mining Engineering	Civil Engineering	Metallurgy	Mining Geology
SECOND YEAR	SECOND SEMESTER	Integral Calculus General Metallurgy Fuel Analysis Mine Surveying Mining Methods Electrical Measurements Fire Assaying Spanish, German or French English	Integral Calculus Geodetic Astronomy Fuel Analysis General Metallurgy Masonry Construction Electrical Measurements Spanish, German or French English	Integral Calculus Metallurgy of Gold-Silver Fuel Analysis Electrical Measurements Fire Assaying Spanish, German or French English	Dynamical Geology Rock Analysis Petography of Igneous Rocks Biology Electrical Measurements Fire Assaying Spanish, German or French English
	SUMMER	Mine Surveying Mining Laboratory Mining Field-work	Railroad Surveying Topographic Surveying Special Field-work	Surveying Assaying Metallurgical Laboratory	Geological Field-work Surveying Petrological Laboratory
THIRD YEAR	FIRST SEMESTER	Analytic Mechanics Hydraulics Railroad Surveying Principles of Geology Water Analysis Wet Assaying Machine Design Powers and Power-Transmission English	Analytic Mechanics Hydraulics Railroad Location Principles of Geology Water Analysis Municipal Engineering Machine Design Powers and Power-Transmission English	Analytic Mechanics Hydraulics Topographic Drawing Genesis of Ores Water Analysis Metallurgy of Copper Wet Assaying Ore Concentration Ore Dressing Laboratory English	Structural Geology Stratigraphical Geology Topographic Drawing Genesis of Ores Special Problems Paleontology Spanish, German or French English

SCHEDULE OF STUDIES—Continued.

		Mining Engineering	Civil Engineering	Metallurgy	Mining Geology
THIRD YEAR	SECOND SEMESTER	Analytic Mechanics Stresses Graphic Statics Masonry Construction Testing Laboratory Iron and Steel Analysis Steam Engine Laboratory Mining Engineering Non-Metallic Mineral Deposits English	Analytic Mechanics Stresses Graphic Statics Testing Laboratory Irrigation Surveys Iron and Steel Analysis Steam Engine Laboratory Mining Engineering Non-Metallic Mineral Deposits English	Analytic Mechanics Stresses Non Metallic Mineral Deposits Mining Industry Principles of Mining Metallurgical Laboratory Metallurgy of Iron Iron and Steel Analysis Machine Design English	Non-Metallic Mineral Deposits Practical Geology Mining Industry Principles of Mining Special Investigations Geologic Surveying English
	SUMMER	Special Assaying Mining Field-work	Hydrographic and Irrigation Surveying	Special Assaying Meta lurgical Inspection Ore Dressing Laboratory	Mine Examinations Geological Field-work
FOURTH YEAR	FIRST SEMESTER	Mine Administration Mining Law Mine Examinations Genesis of Ores Mining Laboratory Theory of Construction	Geodetic Surveying Mine Surveying Theory of Construction Two Electives	Metallurgical Investigation Chemical Methods Ore Dressing Investigation Powers and Power-Transmission Theory of Construction	Geologic Research Geologic Surveying Geologic Correlation Ore Deposition
	SECOND SEMESTER	Mining Construction Mining Design Mining Industry Contracts Thesis	Engineering Construction Engineering Design Contracts Non-Metallic Deposits Thesis	Metallurgical Construction Metallurgical Design Steam Engine Laboratory Thesis	Geologic Philosophy History of Geology Thesis

SYNOPSIS OF COURSES.

MATHEMATICS.

Acting Professor Atkinson, Professor Magnusson and Professor O. R. Smith.

I. ALGEBRA. Five hours a week for 34 weeks. Offered to those who do not come prepared in College Algebra at time of entrance. May accompany Trigonometry. *Acting Professor Atkinson.*

II. PLANE TRIGONOMETRY. Five hours a week, 8 weeks. *Acting Professor Atkinson.*

III. SPHERICAL TRIGONOMETRY. Five hours a week, 6 weeks. Prerequisite is Plane Trigonometry. *Acting Professor Atkinson.*

IV. DESCRIPTIVE GEOMETRY. Three hours a week, 34 weeks. *Professor Smith.*

V. ANALYTICAL GEOMETRY. Five hours a week, 17 weeks. Prerequisite is Plane Trigonometry. *Professor Magnusson.*

VI. DIFFERENTIAL AND INTEGRAL CALCULUS. Three hours a week, 34 weeks. Should be preceded by General Physics, and Analytical Geometry. *Professor Magnusson.*

VII. DIFFERENTIAL EQUATIONS. Two hours a week, 34 weeks. *Professor Magnusson.*

VIII. GEODETIC ASTRONOMY. Three hours a week, 17 weeks. Lectures and demonstrations. Should be preceded or accompanied by Plane Trigonometry. *Professor Smith.*

PHYSICS.

Professor Magnusson.

I. GENERAL PHYSICS. Five hours a week, 17 weeks. Lectures and demonstrations. Should be preceded or accompanied by Plane Trigonometry. *Professor Magnusson.*

II. PHYSICAL MEASUREMENTS. Six hours a week, 17 weeks. Must be preceded by General Physics. *Professor Magnusson.*

III. Electricity and Magnetism. Three hours a week, 17 weeks. Lectures and demonstrations. *Professor Magnusson.*

IV. Electrical Measurements. Four hours a week, 17 weeks. Should be preceded by General Physics and Physical Measurements; and by, or accompany, Electricity and Magnetism. *Professor Magnusson.*

V. Light. Five hours a week, and one afternoon a week, for 5 weeks. Special lectures and laboratory work. Introductory to Optical Mineralogy. Must be preceded by Crystallography. *Professor Gordon.*

VI. Physical Properties of Minerals. Five hours a week, and one afternoon, for 12 weeks. Lectures and laboratory examinations. Must be preceded by Crystallography and Light. *Professor Gordon.*

MECHANICS.

Professor Smith.

I. Analitical Mechanics. Three hours a week, for 17 weeks, first half-year. Preceded by Differential and Integral Calculus. *Professor Smith.*

II. Analytic Mechanics. Three hours a week, 17 weeks, second half-year. *Professor Smith.*

CHEMISTRY.

Professor Noble and Professor Riddell

I. Elementary Inorganic Chemistry. Three hours a week, for 17 weeks. Primarily for those in special prospecting course, and for students not fully prepared in the elements of chemistry. *Professor Noble.*

II. Inorganic Chemistry. Nine hours a week, for 17 weeks. Introductory chemical course to all engineering, metallurgical and geological courses. *Professor Noble.*

III. Qualitative Analysis. Nine hours a week, for 17 weeks, includes also informal laboratory talks and weekly quizzes. *Professor Noble.*

IV. Quantitative Analysis. Nine hours a week, for 17 weeks. Embraces informal laboratory talks and weekly written exercises. *Professor Noble.*

V. THEORETICAL CHEMISTRY. One hour a week, for 17 weeks. Primarily for students who have taken all previous courses. *Professor Noble.*

VI. INDUSTRIAL INORGANIC CHEMISTRY. Three hours a week 17 weeks. *Professor Noble.*

VII. ELEMENTARY ORGANIC CHEMISTRY. Two hours a week for 17 weeks. Introductory to the chemistry of carbon. *Professor Noble.*

VIII. INDUSTRIAL ORGANIC CHEMISTRY. Three hours a week for 17 weeks. Optional. *Professor Noble.*

IX. FUEL ANALYSIS. Six hours a week for 10 weeks. Advanced work especially designed for metallurgical students. *Professor Noble.*

X. WATER ANALYSIS. Six hours a week for 7 weeks. Special investigation of locomotive and boiler waters. *Professor Noble.*

XI. IRON ANALYSIS. Three hours a week, for 17 weeks. Adapted particularly to civil engineering courses. *Professor Noble.*

XII. ROCK ANALYSIS. Three hours a week, for 17 weeks. Primarily for students in ore genesis. *Professor Noble.*

XIII. INVESTIGATION OF CHEMICAL METHODS. Six hours a week, for 17 weeks. *Professor Noble.*

XIV. CHEMICAL ENGINEERING. Five hours a week, for 34 weeks; and laboratory. *Professor Noble.*

ASSAYING.

Acting Professor Riddell.

I. OUTLINES OF FIRE ASSAYING. Elementary practice for special prospecting course. Five hours a week, for 17 weeks. *Acting Professor Riddell.*

II. FIRE ASSAYING. Two days a week for 17 weeks. *Acting Professor Riddell.*

III. WET ASSAYING. Thoroughly practical course in determination of constituents of ores and metallurgical products. Three afternoons a week for 17 weeks. *Acting Professor Riddell.*

IV. BLOWPIPE ASSAYING. For use in the field, primarily for special prospecting course. Three hours a week for 17 weeks. *Acting Professor Riddell.*

METALLURGY.

Professor Noble.

I. General Metallurgy. Three hours a week for 17 weeks. *Professor Noble.*

II. Metallurgy of Lead. Two hours a week for 17 weeks. *Professor Noble.*

III. Metallurgy of Gold and Silver. Two hours a week for 17 weeks. *Professor Noble.*

IV. Metallurgy of Copper. Two hours a week for 17 weeks. *Professor Noble.*

V. Metallurgy of Iron. Two hours a week for 17 weeks. *Professor Noble.*

VI. Metallurgical Laboratory. Two days a week for 17 weeks. *Professor Noble.*

VII. Metallurgical Investigation Ten hours a week for 17 weeks. *Professor Noble.*

VIII. Metallurgical Inspection. Special excursions to metallurgical plants. *Professor Noble.*

IX. Metallurgical Seminar. Bi-weekly. *Professor Noble.*

X. Metallurgical Journal Club. Bi-weekly, alternating with Seminar. *Professor Noble.*

XI. Thesis. Three days a week for 17 weeks. *Professor Noble.*

ORE DRESSING.

Acting Professor Riddell.

I. Ore-Dressing and Concentration. Three hours a week for 17 weeks. *Acting Professor Riddell.*

II. Ore-Dressing Laboratory. One day a week for 17 weeks. *Professor Riddell.*

III. Ore-Dressing Investigation. One day a week for 17 weeks. *Professor Riddell.*

SURVEYING.

Professor Smith.

I. General Surveying. Three hours a week, 17 weeks (lectures), and 13 hours a week, field practice; first half-year. Introductory to all engineering courses. *Professor Smith.*

II. Railroad and Irrigation Surveying. Three hours a week, 17 weeks (lectures), and twelve hours a week field practice; second half-year. Required of all taking civil engineering courses. *Professor Smith.*

III. MINE SURVEYING. Three hours a week for 17 weeks, lectures, and twelve hours a week field practice. Required of all taking mining and metallurgical courses. *Professor Smith.*

IV. SPECIAL TOPOGRAPHICAL AND GEOLOGIC SURVEYING. Two hours a week (lectures); and six hours a week field practice for 17 weeks. *The President.*

V. SUMMER FIELD-WORK. Summer term, 4 weeks; or special party work 15 weeks.

ENGINEERING.

Professors Smith, Crenshaw and Magnusson.

I. HYDRAULICS. Two hours a week for 17 weeks. Optional in metallurgical course. *Professor Smith.*

II. STRESSES AND FRAME STRUCTURES. Three hours a week, 17 weeks. All engineering courses. *Professor Smith.*

III. POWER AND POWER-TRANSMISSION. Four hours a week, 17 weeks. Subjects of the steam engine, and electricity are considered in detail. *Professor Smith.*

IV. THEORY OF CONSTRUCTION. Two hours a week, 17 weeks. Required in all engineering courses. *Professor Smith.*

V. MASONRY CONSTRUCTION Three hours a week, 17 weeks. *Professor Smith.*

VI. MINE CONSTRUCTION. One hour a week for 17 weeks. To be taken in connection with Mining Design.

VII. METALLURGICAL CONSTRUCTION. One hour a week for 17 weeks. To be taken with Metallurgical Design.

VII. ELECTRICAL ENGINEERING. Three hours a week, 34 weeks. *Professor Magnusson.*

VIII. RAILWAY CONSTRUCTION. Three hours a week, 17 weeks. Location, construction and maintenance. Preceded by Railway Surveying. *Professor Smith.*

X. CONTRACTS AND SPECIFICATIONS Two hours a week, 17 weeks.

XI. STEAM ENGINE LABORATORY. Time and work arranged.

XII. TESTING LABORATORY. Time and work arranged.

XIII. ENGINEERING SEMINAR. Bi-weekly colloquium.

XIV. JOURNAL CLUB. Fortnightly. Discussion of current engineering literature.

DRAUGHTING AND DESIGN.

I. FREEHAND DRAWING. Four hours a week for 17 weeks. By arrangement the course may be continued through the year.

II. MECHANICAL DRAWING. Four hours a week throughout the year, 34 weeks.

III. PLOTTING SURVEYS. Two hours a week, 17 weeks. To be preceded by Mechanical Drawing.

IV. TOPOGRAPHICAL DRAWING. Three hours a week, 17 weeks.

V. LETTERING AND TITLES. Four hours a week, 17 weeks. Preceded by Mechanical Drawing.

VI. GRAPHICAL STATICS. Four hours a week, 17 weeks. Lectures and practice.

VII. MACHINE DESIGN. Six hours a week, 17 weeks. Lectures and practice. Preceded, or accompanied, by Mechanics.

VIII. ENGINEERING CONSTRUCTION. Four hours a week throughout the year, 34 weeks.

IX. METALLURGICAL DESIGN. Six hours a week throughout the year, 34 weeks. Lectures and practice.

X. MINING DESIGN. Six hours a week, throughout the year, 34 weeks.

XI. TOPOGRAPHICAL MAPPING. Six hours a week, 17 weeks.

XII. ENGRAVING. Two hours a week, 17 weeks. Lectures and practice in preparing drawings for mechnical reproduction, in printing.

MINING.

I. PRINCIPLES OF MINING. Three hours a week, 17 weeks. Prerequisite: Principles of Geology. Accompanied by Mining Field-Work.

II. MINE SURVEYS. Three hours a week, 17 weeks. For field-work in connection, see under Surveying. *Professor Smith.*

III. SPECIAL MINING METHODS. Two hours a week, 17 weeks. Preceded by Principles of Mining; and accompanied by Mine Examinations.

IV. MINING LABORATORY. Six hours a week, 17 weeks. Precedes, or accompanies, Principles of Mining, and also Mining Engineering.

V. MINING ENGINEERING, I. Three hours a week, 17 weeks. Lectures and field-work. Continuation of Principles of Mining.

VI. MINING ENGINEERING, II. Two hours a week, 17 weeks. Continuation of Mining Engineering I.

VII. MINING ENGINEERING, III. Three hours a week, 17 weeks. Continuation of Mining Engineering, II.

VIII. Mining Field-Work. Twenty hours a week, 17 weeks. Accompanies Principles of Mining, and Mining Engineering. Must be preceded by Principles of Geology and Types of Ore-Deposits.

IX. Mine Examinations. Twenty hours a week, 17 weeks; or equivalent time.

X. Mine Administration. Two hours a week, 17 weeks. Supplemented by special lectures by mine managers.

XI. Mining Law. One hour a week, 17 weeks. Lectures by distinguished attorneys.

XII. Special Mining Problems. Fortnightly lectures by specialists.

XIII. Mining Seminar. Bi-weekly throughout the course.

XIV. Journal Club. Bi-weekly, on alternate weeks with the seminar.

MINING GEOLOGY.

The President.

I. Genesis of Ore-Deposits. Three hours a week, 8 weeks. Preceded by Principles of Geology, Dynamical Geology, Descriptive Mineralogy, General and Experimental Chemistry. Accompanied by Field Work. *The President.*

II. Types of Ore-Deposits Three hours a week, 9 weeks. Preceded by Genesis of Ore-Deposits. Accompanied by Field-Work. *The President.*

III. Mining Industry. Two hours a week, 17 weeks. Field examinations and special seminar work are required. Preceded by Genesis, and Types of Ore Deposits. *The President.*

IV. Non-Metallic Mineral Deposits. Three hours a week, 17 weeks. Special field-work advised. *The President.*

V. Field Excursions. Ten hours a week, 17 weeks, or equivalent time. Primarily for mining engineering course. Accompanies Genesis of Ore-Deposits and Types of Ore-Deposits. *The President.*

VI. Summer Field-Work. Summer term, 12 weeks. Primarily for those taking course in Geology of Mineral Deposits.

VII. Practical Geology Three hours a week, 17 weeks. *The President.*

VIII. SPECIAL INVESTIGATIONS. Ten hours a week, 17 weeks. Primarily for those taking course in Geology of Mineral Deposits. *The President.*

IX. RESEARCH WORK. Ten hours a week, 17 weeks. Primariily for those in course in Geology of Mineral Deposits. *The President.*

X. THESIS. *The President.*

XI. HISTORY OF OPINION OF ORE DEPOSITION. One hour a week, 7 weeks. *The President.*

XII. PRINCIPLES OF ORE DEPOSITION. One hour a week, 7 weeks. Lectures by specialists.

XIII. SEMINAR. Bi-weekly. *The President.*

GEOLOGY.

Professor Gordon.

I. PRINCIPLES OF GEOLOGY. Five hours a week, 17 weeks. Required in all courses. Preceded by General Physics, General Chemistry, and Descriptive Mineralogy. *Professor Gordon.*

II. DYNAMICAL GEOLOGY. Five hours a week, 17 weeks. Preceded by Principles of Geology. *Professor Gordon.*

III. STRUCTURAL GEOLOGY. Three hours a week, 17 weeks. *Professor Gordon.*

IV. STRATIGRAPHICAL GEOLOGY. Two hours a week, 17 weeks. *Professor Gordon.*

V. FIELD EXCURSIONS. Six hours a week, 17 weeks. To accompany Principles of Geology. *Professor Gordon.*

VI. FIELD WORK Five hours a week, 34 weeks. Accompanies Dynamical, Structural and Stratigraphical courses in Geology. *Professor Gordon.*

VII. SPECIAL PROBLEMS. Fifteen hours a week, 17 weeks. Chiefly field work and laboratory. Primarily for those taking courses in mining geology; and graduate students in geology. *Professor Gordon.*

VIII. RESEARCH WORK. Amount of time, character of work, and specific problems arranged. *Professor Gordon.*

IX. EXPERIMENTAL GEOLOGY. Five hours a week, 17 weeks.

X. HISTORY OF GEOLOGICAL SCIENCE. One hour a week, 6 weeks. Optional in all courses.

XI. GEOLOGICAL PHILOSOPHY. One hour a week, 5 weeks.

XII. METHODS OF GEOLOGICAL CORRELATION. One hour a week, 6 weeks.

XIII. GEOLOGIC SURVEYING. Time and details of work arranged.

MINERALOGY AND PETROLOGY.

Professor Gordon.

I. CRYSTALLOGRAPHY. Eight hours a week, 10 weeks. Preceded by Trigonometry. *Professor Gordon.*

II. PHYSICAL MINERALOGY. Eight hours a week 7 weeks. Prerequisites: General Physics and General Chemistry. *Professor Gordon.*

III. DESCRIPTIVE MINERALOGY. Three hours a week, 17 weeks. Preceded by Crystallography, Physical Mineralogy and Principles of Geology. *Professor Gordon.*

IV. BLOWPIPE ANALYSIS. One afternoon a week throughout the year. *Professor Noble.*

V. ADVANCED MINERALOGY. Time and character of work arranged. *Professor Gordon.*

VI. MINERALOGICAL LABORATORY. Six hours a week, 17 weeks. Accompanies Descriptive Mineralogy. *Professor Gordon.*

VII. MICROSCOPICAL PETROGRAPHY. Five hours a week, 17 weeks. To be preceded by all mineralogical courses except advanced mineralogy. *Professor Gordon.*

VIII. PETROLOGY OF THE IGNEOUS ROCKS. Three hours a week, 17 weeks. Preceded by Microscopical Petrography, Principles of Geology and Dynamical Geology. *Professor Gordon.*

IX. PETROLOGICAL LABORATORY. Time and work arranged. *Professor Gordon.*

X. FIELD WORK. *Professor Gordon.*

BIOLOGY.

Professor Gordon.

I. GENERAL BIOLOGY. Three hours a week (lectures), and six hours a week laboratory work, for 17 weeks. To be preceded or accompanied by General Chemistry. *Professor Gordon.*

II. INTRODUCTORY PALEONTOLOGY. Four hours a week, 17 weeks. Preceded by General Biology and Principles of Geology. *Professor Gordon*

III. BOTANICAL LABORATORY. Three hours a week, 17 weeks. Preceded by General Biology and General Chemistry.

IV. BIOLOGICAL GEOLOGY. One hour a week, 17 weeks.

LANGUAGES.

Professor Drake.

I. SPANISH. Five hours a week throughout the year (34 weeks.) First year's work. *Professer Drake.*

II. SPANISH. Five hours a week throughout the year (34 weeks.) Second year's work. *Professor Drake.*

III. SPANISH. Five hours a week throughout the year (34 weeks.) Third year's work. *Professor Drake.*

IV. SPANISH. Five hours a week throughout the year (34 weeks.) Fourth year's work. *Professor Drake.*

V. GERMAN. Five hours a week throughout the year (34 weeks.) First year's work. *Professor Drake.*

VI. GERMAN. Five hours a week throughout the year (34 weeks.) Second year's work. *Professor Drake.*

VII. GERMAN. Five hours a week throughout the year (34 weeks.) Third year's work. *Professor Drake.*

VIII. FRENCH. Five hours a week throughout the year (34 weeks.) First year's work. *Professor Drake.*

IX. FRENCH. Five hours a week throughout the year (34 weeks.) Second year's work. *Professor Drake.*

X. ENGLISH. Three hours a week throughout the year (34 weeks.) First year's work . *Professor Drake.*

XI. ENGLISH. Three hours a week throughout the year (34 weeks.) Second year's work. *Professor Drake.*

XII. ENGLISH. One hour a week throughout the year (34 weeks.) Third year's work. *Professor Drake.*

DEPARTMENTS OF INSTRUCTION.

MATHEMATICS.

ACTING PROFESSOR ATKINSON, PROFESSOR MAGNUSSON, AND PROFESSOR CRENSHAW.

Constituting as they do the foundation of the several general courses for which the School was primarily established, the various subjects in mathematics are given first attention. Elementary mathematics are placed as far forward in the courses as possible in order that the higher subjects and the engineering studies may come in proper sequence without prolonging the time beyond the four-year period leading up to the engineer's degree.

Subjects in this department are taught with special reference to their usefulness as indispensable tools in the engineer's workshop. No attempt is made to extend the courses into higher pure mathematics. The faculty of independent reasoning is assiduously cultivated. One of the main objects sought is to aid the student in acquiring the ability to properly and readily develop formulæ and to supply their demonstration. Every effort is made to secure practical familiarity with the application of the more elementary subjects to the solution of the problems in the higher work.

The prescribed courses begin with plain trigonometry. This is somewhat in advance of what is usually required for college entrance. This arrangement, however, gives a more satisfactory sequence to the later engineering courses. For those who wish to matriculate in the School but who have not completed college algebra a full course is offered in this subject which may accompany first-year mathematics.. Other deficiencies in mathematics if not too serious may be made up in the college preparatory school under the supervision of the School of Mines, in connection with the Socorro High School.

I. Algebra. Acting Professor ATKINSON.

Quadratic equations, fractional and negative indices, imaginary and complex quantities, the progressions and other simple series, inequalities and limits, permutations and combinations, binominal theorem for any index, undetermined coefficients, exponentials, and logarithms, terminants, and elements of the theory of equations.

A complete course offered to students who do not come fully prepared in college algebra at time of entrance. May accompany trigonometry.

Five hours a week for 34 weeks.

Wentworth's College Algebra is the text-book used.

II. Plane Trigonometry. Acting Professor ATKINSON.

A combination of the ratio and line systems is used, special attention being given to transformation of trigonometric expressions, solutions of trigonometric equations, and rigorous dealing with the fundamental series of trigonometry.

College Algebra is prerequisite, or may be taken with this course.

Five hours a week, for 8 weeks, in the first half-year.

Phillips and Strong's Elements of Plane and Spherical Trigonometry is the text used.

III. Spherical Trigonometry. Acting Professor ATKINSON.

This course is a continuance of the preceding course. It in-

cludes the solution of spherical triangles, and the application of spherical trigonometry to the simple problems of spherical astronomy.

Five hours a week, for 6 weeks, during first half-year.

The same text is used as in the previous course.

IV. Descriptive Geometry. Professor SMITH.

Instruction is given both by lectures and work in the draughting-room. After some preliminary work in connection with Mechanical Draughting, there is a series of lectures illustrated by means of diagrams and models. Use is also made of the text-book. The problems proposed in the lectures are afterwards solved graphically.

The work includes the solution of practical problems relating to straight and curved lines, plane and curved surfaces, and solids, by the methods of orthographic projection. Interpenetration of surfaces, shades and shadows, and the theory of perspective, are entered into, until the student is thoroughly familiar with the subject.

Three hours a week, for 34 weeks. To be preceded or accompanied by Mechanical Drawing.

Text-book: Low's Practical Solid or Descriptive Geometry.

V. Analytic Geometry. Professor MAGNUSSON.

The analytic geometry of the straight line, the circle, and the conic sections, is covered. The course includes also the transformation of co-ordinates, a discussion of the general equation of the second degree, and an introduction to the analytic geometry of space. Prerequisite is Plane Trigonometry.

Five hours a week, second half-year (17 weeks.)

Ashton's Plane and Solid Analytic Goemetry is the text used.

VI. Differential and Integral Calculus. Professor MAGNUSSON.

The subjects treated are the development of the basic principles and formulæ of the calculus; differentiation of functions, development of functions into series, evaluation of indeterminate forms; maxima, minima, lengths of curves, areas, volumes, centers of gravity, and other applications of the methods of differentiation and integration to problems in geometry and analysis.

Three hours a week, throughout the year (34 weeks). Prerequisite is Analytic Geometry.

The text-book used is Osborne's Differential and Integral Calculus.

VII. Differential Equations. Professor Magnusson

This course is a systematic but brief exposition of some of the devices employed in solving differential equations. The work is especially adapted to the needs of students in physics and engineering who wish to use the subject as a tool. Numerous practical applications are given.

Two hours a week, for 34 weeks.

Text-book: Murray's Differential Equations.

VIII. Geodetic Astronomy. Professor Smith.

This course is intended to give the student practical knowledge of those principles of astronomy which are the foundations of geodesy. It comprises discussions of the sun, planets, satellites and stars, and their apparent motions; and the determination of their positions in the celestial sphere. Astronomical instruments, the sexant, transit, zenith, telescope, altazimuth, their adjustments and uses, are explained. Attention is given to the methods of determining latitude, time and azimuth.

Five hours a week, 17 weeks. To be preceded by Analytic Geometry.

Hayford's Text-book on Geodetic Astronomy is used.

PHYSICS.

Professor Magnusson and Professor Crenshaw.

In organizing the Department of Physics there was borne in mind the practical needs of the engineering student rather than intrinsic symmetry and completeness, or attempts to provide for original investigation. Instruction is given by means of lectures and recitations. These are accompanied by laboratory practice which is for the most part quantitative in character.

The experiments are chosen with special reference to their exemplification of the principles which lie at the base of physical science, and to their subsequent usefulness to the mining engineer. Logical and independent thinking is a faculty which the courses all aim to develop. Effort in the laboratory should be spontaneous and original and not merely mechanical.

Experimentation is planned to familiarize the student with the manner of making accurate determinations, of properly manipulating and adjusting the instruments used in making precise measurements, and of intelligently recording, interpreting and reducing the data obtained. Besides the training in method and in the use

of apparatus which the earlier courses are intended to give, the student arrives at a better understanding of the laws of physics and of the real significance of physical constants.

As the work is advanced, attention is called to the possible sources of error in observation, record and deduction. Methods employed in eliminating error and in reducing it to a minimum are discussed.

The laboratory work of each student is chiefly individual in character. In a measure the details in each instance are determined by the student's general course.

While the schedule for physics here given includes for the present only two general courses with their accompanying laboratory work, two other courses, which, however, are more strictly mineralogical in character, are open to students desiring further instruction in certain phases of the subject. Facilities are also provided for much more extensive work in the different branches of physics. For these the time and details may be arranged.

Four rooms in the basement of the chemical building are set aside for the physical laboratories, insuring the most favorable conditions with reference to stability and constant temperatures.

Additional equipment is yearly made to the physical laboratory.

I. General Physics. Professor MAGNUSSON.

In the first course in physics the instruction is by means of lectures, demonstrations, recitations and assigned problems. The properties of matter, elementary mechanics, heat, sound, light, electricity and magnetism are considered with reference to the principles which control the measurements in the laboratory, and which underlie the applications.

The various branches are treated both mathematically and experimentally. In this course the foundations are laid for all later work, whether it relates directly to the experimental, technical or theoretical departments of the general subject.

Three hours a week for 34 weeks. Preceded by Plane Trigonometry.

The text-book used is Carhart's University Physics.

II. Physical Measurements. Professor MAGNUSSON.

As an accompaniment to General Physics the introduction to physical measurements is designed to teach the student how to manipulate properly the apparatus, the degree of precision necessary under given conditions, and the methods of recording results.

A point to which attention constantly recurs is the correction of errors of observation and of conditions.

Experiments are given in mechanics, sound, light, heat, electricity and magnetism, in each case during the time this topic is studied in the class room of general physics.

Four hours a week, for 34 weeks. Accompanies lectures on General Physics.

III. Electricity and Magnetism. Professor CRENSHAW.

A mathematical course in electricity and magnetism.. The electromagnetic theory as conceived by Farady and perfected by Maxwell is accepted as the true exposition of the phenomena of electricity, magnetism and light. A set of differential equations, known as Maxwell's equations, form the basis upon which this theory rests. These equations and the consequences following the application of the principles of mathematics to various phases of electricity and magnetism are the main topics treated in this course.

Prerequisites: Courses I and II in Physics, and Differential and Integral Calculus.

Three hours a week, 34 weeks.

IV. Electrical Measurements. Professor CRENSHAW.

The course is intended primarily for those students who desire to know something of the latest methods in use in electrical science. The various classes of measurement are taken up in turn. With some modifications the course will soon be adapted to the students who desire to take up electrical engineering.

Five hours a week, 17 weeks.

Nichols' Laboratory Manual of Physics and Applied Electricity, and Carhart and Patterson's Electrical Measurements are used.

V. Light. Professor GORDON.

Primarily an introductory to Optical Crystallography. Lectures and laboratory work. Fuller particulars will be found under Mineralogy.

After the general subject of light is briefly reviewed the principal topics taken up are the passage of light from one isotropic medium into another, the passage of light through homogeneous anisotropic media, and the practical determination of crystals by their action on transmitted light.

Particular attention is given to the subject of polarization, the optical constants of biaxial crystals, and the behavior of their crystal sections between Nicol prisms both in parallel and in converged light.

The equipment for experimentation in this course is very complete.

Five hours a week, and laboratory work one afternoon a week, for 5 weeks.

VI. Physical Properties of Minerals. Professor GORDON.

A continuation of the course on Light, in which the physical characters of crystals other than exhibited by light, are considered. Cohesion, elasticity, specific gravity, heat, electricity and magnetism as presented by crystal bodies, are discussed and the various phenomena illustrated. Students taking this course in connection with mineralogy get ample practice in the laboratory, where also use is made of the petrographical microscope.

Five hours a week and one afternoon a week, for 12 weeks.

Dana's Text-book of Mineralogy is followed.

ELECTRICAL ENGINEERING.

PROFESSOR MAGNUSSON.

The electrical engineering course is primarily adapted to the modern applications of electricity to mining. The general work is largely along the same lines as in the regular mining engineering course, except greater attention is given to physics, electrical measurements, and the subjects relating more directly to the mechanisms used in the electrical industries. Special mathematical studies are also included. Important features of the course are the special readings and the seminar work.

Particular attention is given to the applications of electricity. The generation and transmission of electricity comes in for detailed consideration; as does also the utilization of water powers for generation in mountain regions.

Altogether the course is one that is evenly balanced both in its theoretical and practical aspects.

I. Electrical Engineering. Professor MAGNUSSON.

The course offered in electrical engineering is especially adapted to the needs of the mining engineer. Not only is the theoretical side treated, but special emphasis is laid on the use of electrical apparatus in mining, for power, light and ore treatment. The theory, construction and care of ammeters, voltmeters and waltmeters for both direct and alternating currents are given in detail.

The fundamental principles of the various types of dynamos

and motors and the advantages and drawbacks of each type for mining problems are treated at length.

Three hours a week for 17 weeks.

Text: Electrical Machinery by Ryan, Morris and Hoxie.

II. Electrical Engineering, II. Professor MAGNUSSON.

A continuation of Electrical Engineering I.

Three hours a week for 17 weeks.

ANALYTIC MECHANICS.

PROFESSOR SMITH.

In the main the various subjects included are mathematically considered. The practical application of the principles is always kept prominently in view, and later, laboratory tests are taken up.

The general laws of dynamics and kinematics are first treated, and subsequently the subjects of stresses and the strength of materials. Throughout the courses the results of the most recent experimentation are discussed.

Numerous problems of a practical character are presented for solution, in the majority of cases selected with special reference to the structures and machinery with which the student is already more or less acquainted, or with which he is soon likely to come in contact.

I. Analytic Mechanics. Professor SMITH.

Forces, first in their relations to each other, and second the motions which they cause in the bodies to which they are applied, are treated.

In statics there are considered the composition, resolution and properties of concurrent and non-concurrent forces in equilibrium, centers of gravity, couples, and the statics of flexible cables.

In dynamics there are dealt with bodies in motion, uniformly accelerated, and variably accelerated, rectilinear motions, falling bodies of impact, curvilinear motion, centrifugal force, pendulums, and projectiles, moments of inertia, rectangular and polar, work, energy and power, of motors, dynamometers and the measurement of power and friction and the transmission of power. A large number of practical problems relating to work, power and transmission are proposed for solution. Calculus is prerequisite.

Three hours a week, for 17 weeks, first half year.

Church's Mechanics of Engineering is the text followed.

II. Analytic Mechanics. Professor SMITH.

In dealing with the strength of materials the following are the principal topics treated. The mechanics of materials deals with the stresses and deformations produced in bodies of various forms and materials by forces variously applied; tension, compression of short and long columns and shear; flexure of beams, elastic curves and safe loads; continuous girders; introduction to Graphical Statics. Preceded by Analytic Mechanics I.

Three hours a week, second half-year.

Church's Mechanics of Engineering is the text, as in the preceding course.

CHEMISTRY.

PROFESSOR NOBLE AND ACTING PROFESSOR RIDDELL.

The chemical department of the College affords opportunity for the student to obtain a good general knowledge of the subject of inorganic chemistry, and acquire a practical working knowledge of qualitative chemical analysis. In addition to this, each student is required to take a course in quantitative analysis especially adapted to the line of studies he is pursuing.

The civil engineering student takes iron and steel analysis; the mechanical engineering student, fuel and water analysis; and the mining and metallurgical student, wet and fire assaying.

The greater part of the time devoted to chemistry is spent in the laboratories.

Lectures and recitations are made dependent upon individual laboratory experiments, and faithful work in the laboratory is made as much a requisite for graduation as the passage of a good examination.

Each student, by the time he is graduated from the College, has a good theoretical knowledge of chemical science, a special practical training in qualitative analysis, and an insight into some branch or branches of quantitive analysis. He is thus fitted to cope intelligently with chemical problems which may arise in the course of his future work, and is familiar with the methods of quantitative analysis most important to his profession. Moreover, he can take up with confidence any new form of quantitative analysis he may be called upon to perform. The work of each person studying to be an engineer is particularly adapted to the practical needs of his profession; and it is aimed to give him only so

much of a chemical training as will directly subserve the purposes of his subsequent career.

Ample opportunity is also given those students who are looking forward to the field of industrial chemistry; and adequate courses may be arranged for, along this general line, and in any of its special branches. The laboratories are well equipped for modern and advanced work.

A description of the chemical laboratories and equipment will be found in another place.

In no case will the work of any course be permitted to be taken up until all prerequisite chemical courses shall have been satisfactorily completed.

I. Chemistry of Non-Metals. Professor NOBLE.

In beginning the work in chemistry it is intended to present thoroughly the fundamental laws and theories of the subject and to acquaint the student with the occurrence, preparation, properties and uses of the common non-metallic elements and of their compounds.

This is a course introductory to all engineering, metallurgical and geological courses. The lectures, recitations, and laboratory work of this course are so arranged as to give the student a broad view of the field of inorganic chemistry. Great weight is given to the attainment of a scientific view-point, and to the making of accurate and neat records of all experiments performed. Each of the more common elements is studied in turn. Its history, manufacture, properties, relations and compounds are first described in the lecture room; then discussed in class; and finally the substance is investigated experimentally in the laboratory. The student should be prepared with either high school chemistry or elementary inorganic chemistry before entering upon this course..

The time in the class room is largely devoted to quizzes upon assigned subjects, ample opportunity thus being given to correct any erroneous ideas possessed by the student, and to add to his information on the subjects assigned.

Five hours a week, lectures; and nine hours a week in laboratory, 17 weeks, first half year.

Newth's Inorganic Chemistry and Noble's Elementary Chemical Theory are used as texts.

II. Chemistry of Metals. Professor Noble

This course is a continuation of the preceding one, and is taken in connection with the laboratory work in qualitative analysis. The instruction is given in lectures and by class-room work.

The lectures are given weekly, outlining the procedure to be taken up, and explaining the reason for each step. In addition to this, the newly developed theories of solution are fully explained, and their applications to the qualitative procedure are pointed out. Written recitations are held frequently for the purpose of ascertaining individual progress.

Two hours a week, 17 weeks, second half year.

Newth's Inorganic Chemistry is used as a text.

III. Qualitative Analysis. Professor Noble.

The aim of this course is to give the student a thorough working knowledge of qualitative analysis. To secure this result, his attention is at once directed to qualitative procedure. Preliminary reaction work and similar extraneous matter are largely omitted, the time usually devoted to such work being used by the student to greater advantage in obtaining a better knowledge of the principles underlying the procedure and in learning to manipulate with greater skill..

The metals are first taken up and a series of analyses of unknown substances of increasing complexity are made by the student. The acids are then studied in a similar manner.

When entirely familiar with the procedure for both bases and acids, he is required to analyze correctly a number of substances including alloys, soluble salts, insoluble salts, industrial products, minerals, slags, mattes and speises.

Nine hours a week, 17 weeks, second half year..

Fresenius' Manual of Qualitative Chemical Analysis is used for reference and Lyons and Davis' Qualitative Analysis is used as the laboratory manual.

IV. Blowpipe Analysis. Professor Noble.

The order of subject matter is that given in Moses and Parsons' Mineralogy, Crystallography and Blowpipe Analysis, beginning with the ores of iron. At the completion of each group, tests are given on unknown specimens, and the student is expected to identify these without error. The notebooks are submitted at the close of the semester for inspection and are not accepted unless the entire work is satisfactorily written up in the laboratory.

Three hours a week, for 17 weeks.

V. Quantitative Analysis. Professor Noble.

An introductory course in quantitative analysis is offered those students who are just entering upon the subject after taking qualitative analysis. It consists mainly of laboratory work outlined and explained by lectures. The teaching of the modern theories of solutions and their applications is continued, and the subject of stoichiometry is taken up in full. A series of problems to be solved at home and in class gives the student a thorough drilling in this important subject. Class-work, as in the course in qualitative analysis, is mainly in the form of written recitations.

The student first learns to use and to take proper care of chemical balances, crucibles and desiccators. He then manufactures pure salt and analyzes it gravimetrically, after which he analyzes samples of table-salt and calculates their percentage purity. The best methods of keeping note-books are discussed, and the necessity of having them neat, accurate, concise, and comprehensive is pointed out. The great importance of economy of time is shown, and methods of securing it are noted. The student makes gravimetric determinations of the constituents of ferrous ammonium sulphate, apatite, dolomite, brass, limonite, and feldspar.

Volumetric analysis is introduced by instruction in the use, care and calibration of burettes, pipettes and measuring flasks. Standard and normal solutions are then discussed. The three methods of volumetric analysis—saturation, oxidation and precipitation—are each taken up in turn. Volumetric determinations are made of the alkaline strength of soda-ash, the acidic strength of oxalic acid, the percentage of iron in limonite by the bichromate and permanganate processes, of chromium in chrome iron-ore, the oxidizing power of pyrolusite, the percentage of antimony in stibnite, of available chlorine in bleaching powder, of silver in coin, *et cetera.*

Nine hours a week for 17 weeks.

Talbot's Introductory Course of Quantitative Chemical Analysis is followed in the laboratory. Fresenius' System of Instruction in Quantitative Chemical Analysis, and Sutton's Volumetric Analysis are used as books of reference.

VI. Inorganic Preparations. Professor Noble.

In this course special opportunity is offered such students as so desire to further perfect themselves in quantitative work. Chemically pure substances of commercial importance are prepared by the student with constant attention to the securing of maximum yields. Skill in manipulation is encouraged, methods of manipula-

tion not occurring in other courses are practiced, and a general increased knowledge of inorganic chemistry is acquired.

Six hours a week, 17 weeks.

Lengfeld's Inorganic Preparations is used as laboratory manual.

VII. Wet Assaying. Acting Professor RIDDELL.

A thoroughly practical course in the determination of the important constituents of ores and metallurgical products. The methods taught are those in use in the large smelters of the West. The student works upon checked samples of widely varying composition until he becomes familiar with the various methods and can carry them out under all the conditions with accuracy and rapidity.

The School has a large collection of accurately checked samples, including many obtained from the principal smelters of the country. The regular work of the course consists in the assaying of typical ores and metallurgical products. By putting in a little extra time the ambitious student may greatly increase the number of his determinations and thus become decidedly more expert in this work.

The determinations made are lime, magnesia, silica, iron, by the bichromate and permanganate methods, copper by the cyanide and iodide methods, lead by the molybdate method, zinc by the ferrocyanide method, alumina, manganese, baryta, arsenic and sulphur.

Two hours a week, lectures, and 3 afternoons laboratory, for 17 weeks, first half-year.

Furman's Manual of Practical Assaying is the text used.

VIII. Fuel Analysis. Professor NOBLE.

Analyses of solid, liquid, and gaseous fuels and the determination of their heating values are made. A thorough course in fuel-analysis is given, including the calculation of heating power by the calorimeter and theoretically. It includes the analysis of illuminating gas and the determination of its lighting value by means of the photometer, and the analysis and properties of lubricating oils.

Six hours a week, for 9 weeks.

Gills' Oil Analysis, and Gas and Fuel Analysis for Engineers are used as text-books.

IX. Water Analysis. Professor NOBLE.

The analysis of water for manufacturing and domestic purposes is studied and special attention paid to the analysis of waters for use in boilers. The work includes the determination of total

solids, organic and volatile matter, silica, alumina and ferric oxide, magnesia, sodium, potassium, sulphuric acid, chlorine, oxidizable organic matter, free and albuminoid ammonia, and nitrates and the grouping of the constituents.

Six hours a week, for 8 weeks.

Mason's Examination of Water is used as a laboratory manual, and Stillman's Engineering Chemistry is used for reference.

X. Iron and Steel Analysis. Professor Noble.

This course includes the analysis of pig-iron, bar-iron and steel. Both accurate methods and rapid methods are taken up. Determinations are made of sulphur, silicon, slag and oxides, phosphorus, manganese, total carbon, graphite carbon, combined carbon, titanium, copper, nickel and cobalt, chromium and aluminum, arsenic, antimony, tin, tungsten, vanadium, nitrogen and iron.

One afternoon a week, for 17 weeks.

Blair's Chemical Analysis of Iron is used as a text-book.

XI. Rock Analysis. Professor Noble.

The complete analysis of sedimentary, metamorphic, and igneous rocks of complex mineralogical composition. Special stress is laid upon the determination of the minute quantities of metals such as lead, copper, gold and silver present in various types of rocks. Opportunity is given to carry on special investigations along these lines as a part of more extensive inquiry now being prosecuted in the school in connection with researches on ore genesis.

One afternoon a week for 17 weeks.

Bulletin No. 148 of the U. S. Geological Survey is followed, with frequent reference to larger works.

XII. Industrial Inorganic Chemistry. Professor Noble.

The utilization of inorganic materials in manufacturing processes was taken up in an elementary way in connection with Inorganic Chemistry. This special industrial course goes into the subject considerably more in detail.

The manufacturing processes described are mainly those for acids, alkalis, salts, haloids, limes, cements, clays, fertilizers, glasses, mineral-dyes, mineral-paints, explosives and matches.

The aim is to expound the dominant principles underlying each process rather than to present such an account of the details as will suffice for the student of any particular industry. In this manner the student is prepared to study efficiently the literature of

any branch in which he may afterwards become especially interested.

Two hours a week, for 17 weeks, are devoted to this course..

Thorp's outlines of Industrial Chemistry is the text-book followed.

XIII. Organic Chemistry. Professor NOBLE.

This course serves as an introduction to the study of the hydrocarbons of both the fatty and the aromatic series, alcohols, phenols, aldehydes, organic acids, ethers, esters, and carbohydrates. Their formation, relations, substitution products, and derivatives are discussed, and special attention is given to the explanation of familiar organic phenomena and to the solution of problems involving organic reaction. The lectures are illustrated by experiments.

Nine hours a week, 34 weeks, beginning with the first half-year.

Remsen's Organic Chemistry is used as a text.

XIV. Industrial Organic Chemistry. Professor NOBLE.

The utilization of organic materials in the industrial arts is considered. The subjects taken up are: Petroleum and mineral oils, fats and fatty oils, essential oils and resins, cane-sugar, starch and its alteration products, fermentation, milk, vegetable textile-fibres, animal textile-fibres. animal tissues and their products, destructive distillation, artificial dyes, natural dyes, bleaching, dyeing, and textile printing. In each case the raw materials, processes of treatment, and products are fully described, and analytical tests and methods of applying them are discussed.

Special prominence is given to the petroleum and mineral oil industry, and to the destructive distillation of coal. The topics discussed under the first head are natural-gas and its products, illuminating gas, fuel-gas, lamp-black, and electric-light carbons, crude petroleum and its products, ozokerite and natural paraffines and their products, bitumens, asphalts, bituminous shales and their products, and vaseline. Under the destructive distillation of coal are taken up the varieties of coal, distillation in the gas-retort and in the coke-oven, fractional separation of crude coal-tar, treatment of the ammoniacal liquor, light oil, middle oil, heavy oil, anthracene oil, pitch, and gas.

Two hours a week, 17 weeks.

Thorp's Outlines of Industrial Chemistry is the text-book followed.

XV. Physical and Theoretical Chemistry. Professor NOBLE.

The elements of theoretical chemistry have already been studied in the courses in inorganic chemistry, qualitative and quantitative analysis. The subject is here pursued more exhaustively and the physical basis of the subject considered. The laws of mass are first taken up. Under this head are discussed the fundamental laws of chemistry, elements, atomic weights, properties of gases, properties of liquids, solutions, properties of solids, and chemical systematics.

The chemical laws of energy are then discussed. Thermo-chemostry, photo-chemistry, electro-chemistry, chemical dynamics and chemical affinity are the principal subjects dealt with under this head.

Two hours a week, for 17 weeks.

Jones' Outlines of Physical Chemistry is the text used.

XVI. Investigation of Chemical Methods. Professor NOBLE.

The School offers opportunity for advanced research work, the comparison of old methods, their improvement, and the formulation of new methods.

Work carried on in this course may be enlarged upon and worked up as a thesis if the faculty deem it of sufficient importance.

Copious references are made to English, French and German publications.

Six hours a week, for 17 weeks.

XVII. Special Engineering Chemistry. Professor NOBLE.

The chemical and metallurgical courses are clearly allied. Stress is placed upon those classes of industries requiring the supervision of the mechanical engineer and chemist, and which are most commonly located in or near mining districts. The practical bearing of chemical science is kept always in view.

For the first two years the metallurgical and chemical courses are nearly alike. An important factor recognized is the adapting of the mechanical engineer to the demands of industrial chemistry. To this end a large portion of the student's time in the latter part of his course is devoted to the consideration and critical examination of the types of machinery used in chemical industries. In the last year the student specializes along those lines he expects to follow after graduation.

While the chief attention is devoted to those branches of applied chemistry and engineering which have to do with industries naturally belonging to mountain regions, the work need not be necessarily confined to these. A wide range of choice is permitted. The main regulation governing the work is that the rest of the course shall be made to conform rationally to the special end in view.

In the general course in chemical engineering, it is intended to provide the means by which young men may fit themselves for that branch of mechanical engineering which has directly to do with certain kinds of manufacturing in which a knowledge of chemistry plays an important part. Industries of this kind are now rapidly developing in this country, and there is need of engineers, who, in addition to their knowledge of mechanics, are better informed than most mechanical engineers in regard to chemistry.

In the later work a wide range of specialization is permitted, and a number of special courses are given, as demand warrants.

Time and subjects are arranged.

ASSAYING.

Acting Professor Riddell.

The instruction in assaying is given by means of lectures and laboratory experimentation, the practice in the laboratory illustrating the lecture-courses. The courses are preceded by Inorganic Chemistry and Qualitative Analysis. The laboratories are well equipped with several different types of assay-furnaces for crucible work, scorification and cupellation, and with everything that goes to make up a well furnished assay office.

Very complete facilities are also provided for wet-assaying, the lixiviation assays of silver ores, and the cyanide assay and the amalgamation assays of gold ores. The blow-pipe laboratory is fully equipped.

I. Outlines of Fire Assaying. Acting Professor Riddell.

An elementary course in fire assaying, designed for those taking the special prospecting course. Assay of ores by scorification and crucible methods. The work is an abridgement of that given on ores in the next course, Fire-Assaying.

Five hours a week, for 17 weeks.

II. Fire Assaying. Acting Professor RIDDELL.

Fusion methods for gold, silver and lead; the crucible assay of oxidized ores for gold and silver in the muffle and in the pot-furnace; crucible assay of sulphide ores for gold and silver by the iron, roasting, and preliminary fusion methods; also the crucible assay of lead ores. The scorification-assay of mattes and speisses, with preliminary wet treatment; assay of litharge and lead. In the assay of base-bullion, silver-bullion and gold-bullion, the methods in use in the United States mints are followed. Sampling and the preparation of the sample for assay. Making cupels.

Numerous samples are provided, all of which have been previously accurately assayed at the College, at the smelter from whence they came, or at the mint. The student work upon these until he attains a high degree of proficiency. No student is allowed to pass this subject until he has become an experienced assayer.

Two days a week for 17 weeks, lectures and laboratory.

Lecture Assay Notes, and Furman's Manual of Practical Assaying are followed.

III. Wet Assaying. Acting Professor RIDDELL.

A thoroughly practical course in the determination of the important constituents of ores and metallurgical products. The methods taught are those in use in the large smelters of the West. The student works upon checked samples of widely varying composition until he becomes familiar with the various methods and can carry them out under all the conditions with accuracy and rapidity.

The School has a large collection of accurately checked samples, including many obtained from the principal smelters of the country. The regular work of the course consists in the assaying of typical ores and metallurgical products. By putting in a little extra time the ambitious student may greatly increase the number of his determinations and thus become decidedly more expert in this work.

The determinations made are lime, magnesia, silica, iron, by the bichromate and permanganate methods, copper by the cyanide and iodide methods, lead by the molybdate method, zinc by the ferrocyanide method, alumina, manganese, baryta, arsenic and sulphur.

Two days a week, for 17 weeks.

Lecture Notes are used, with Furman's Manual of Practical Assaying, as a reference.

IV. Blowpipe Assaying. Acting Professor RIDDELL.

The assay of ores for gold and silver by means of the blow-pipe, designed for the special course in prospecting. This assay is for use in the field, and is made with a small, simple, and readily portable outfit. The pulp-balance is one that can readily be made by any one out of a few pieces of wood, two pieces of glass-rod, and three needles. The fluxes are measured; and the resulting buttons are measured on a button-scale and calculated into ounces per ton. Notwithstanding its apparent crudity, very good results are obtained by this method, which is of the greatest value to prospectors.

Three hours a week, for 17 weeks.

METALLURGY.

PROFESSOR NOBLE AND ACTING PROFESSOR RIDDELL.

The Metallurgical Department aims to turn out its graduates equipped with the knowledge necessary to the successful management of metallurgical plants, and to take full charge of metallurgical operations. The graduate from this department has acquired a good working knowledge, both theoretical and practical, of assaying, chemistry, mill-work and smelting processes.

Students in mining engineering are given the same theoretical training in metallurgy that metallurgical students receive, but they have not so much of the detailed and practical work.

The courses have been chosen with special reference to giving to the student in metallurgical engineering a general knowledge of modern metallurgy as a whole, and a special knowledge of the metallurgy of each of the more important metals. This special knowledge is attained by lectures, readings, discussions, laboratory work, inspections of metallurgical plants, and actual practice.

I. General Metallurgy. Professor NOBLE.

A general view of the principles and modern processes followed in the extractions of metals from their ores. Fuel. Refractory materials. The metallurgy of lead, copper, gold, silver, platinum, mercury, antimony and all other metals of industrial importance.

Each metal is discussed in the following manner: The metal and its properties, impurities and their effects, compounds and their properties, ores, principles of extraction, and process for extraction. The course confines itself to principles and general descriptions of methods. Details of manipulation and management

may be acquired later in special courses on the metallurgy of lead, copper, iron, gold and silver, to which this course is a prerequisite.

Three hours a week, for 17 weeks.

Lincoln's Notes on General Metallurgy are used.

II. Metallurgy of Lead. Professor NOBLE.

An advanced course in lead metallurgy; occurrence of lead; the lead reverberatory furnace; Corinthian, Silesian and English methods of treating lead ores in the reverberatory furnace; Scotch, American and Moffet types of ore hearths; smelting lead ores in the ore hearth; roasting furnaces for lead ores; roasting galena as a preliminary to blast furnace treatment; the lead blast furnace; calculation of blast furnace charges; details of running a lead blast furnace; desilverization of base bullion.

Two hours a week, for 17 weeks.

Hoffman's Metallurgy of lead is used as a text-book.

III. Metallurgy of Gold and Silver. Professor NOBLE.

Occurrence of gold and silver; placer mining; the Patio process; crushing and amalgamating machinery; pan amalgamation; chlorination by the vat and barrel processes; cyaniding by the MacArthur-Forrest, and Siemens-Halske processes; lixiviation of silver ores; pyritic smelting; refining and parting of gold bullion.

Two hours a week, for 17 weeks.

Rose's Gold, and Eissler's Metallurgy of Silver are used as text-books.

IV. Metallurgy of Copper. Professor NOBLE.

Occurrence of copper; roasting copper ores in heaps, stalls and roasting-furnaces; blast-furnace smelting; pyritic smelting; reverberatory smelting; Bessemerizing copper mattes; electrolytic refining of copper; selection of process and arrangement of plant.

Two hours a week, for 17 weeks.

Peter's Modern Copper Smelting is used as a text-book.

V. Metallurgy of Iron. Professor NOBLE.

Modern methods for the production of pig-iron, wrought-iron, and steel; the iron blast-furnace; white cast-iron, gray cast-iron and spiegel-iron; puddling; wrought-iron; the Bessemer and Siemens-Martin processes; steel.

Two hours a week, for 17 weeks.

Howe's Metallurgy of Steel is used as reference book.

VI. Metallurgical Laboratory. Professor Noble and Acting Professor Riddell.

Two days a week throughout the second term of the third year are devoted to work in the metallurgical laboratory. This includes roasting lead and copper ores, smelting lead, copper and iron ores, cyaniding gold ores, chlorinating silver ores, and amalgamating gold and silver ores. An accurate and complete record is kept of each campaign; and the methods used, difficulties encountered, and results obtained in each campaign are fully discussed and criticized in class.

VII. Metallurgical Investigation. Professor Noble.

Advanced work in the metallurgical laboratory. The work is in the nature of experimenting upon different mixtures of ores and gangues to ascertain the best method of treatment in each instance, and of investigating the comparative merits of appliances and apparatus.

While all work is directly supervised by the instructor in charge, students are encouraged to do the mental work as well as the actual physical work entailed. One whole day and one afternoon a week are set aside for this purpose. Work performed in this course, of sufficient importance, may be subsequently elaborated for a thesis.

VIII. Metallurgical Inspection. Professor Noble.

Visits of inspection to mills and reduction works. While these visits are required during the third year only, at which time the student is capable of understanding all he sees and thus deriving the maximum amount of benefit from it, students not so far advanced are advised to take these trips whenever it does not seriously conflict with other studies.

A visit may be extended by special permission and the mill or reduction works used to furnish the material for a thesis.

IX. Metallurgical Seminar. Professor Noble.

Informal bi-weekly colloquium upon subjects of interest to the practical metallurgist. This includes the discussion of metallurgical work undertaken by the students at the School, as well as questions which may arise which do not rightly come under the head of any of the regular lectures of the School.

Taken by all students in the metallurgical courses; and open to all other persons especially interested.

X. Metallurgical Journal Club. Professor NOBLE.

To each member of this club is assigned one periodical, scientific, mining, or metallurgical. It is then his duty to make a list of all the articles which appear in the periodical and which have a direct bearing upon metallurgy; and to be prepared at any meeting to give an outline of the matter embodied in one or more of these articles, and to discuss the details brought out.

The club meets bi-weekly, alternating with the seminars, and including the same students.

XI. Thesis. Professor NOBLE.

Each student before receiving his degree of Metallurgical Engineer is required to prepare and present to the Faculty an important scientific treatise upon a metallurgical subject. This treatise must be based upon work carried out by the writer while a student at the College. It must contain a complete record of all work performed by the writer upon the subject treated, the conclusions drawn from the work, and a statement of the lines along which, in the writer's opinion, it would be advisable to pursue the investigation further.

These are bound and placed in the College library. Those which appear to be of especial interest or importance are published.

Three days a week for 17 weeks are given up to thesis work. This time may be differently arranged by special permission, so that a student may work upon his thesis continuously while on a visit to a mill or reduction works, some feature of which is serving as a basis for his thesis.

ORE-DRESSING.

ACTING PROFESSOR RIDDELL.

The principles of ore-dressing and concentration are taken up in General Metallurgy. The further work on this subject is designed to give to the metallurgical student a thorough knowledge of the actual working aspects of the subject.

I. Ore-Dressing and Concentration. Acting Professor RIDDELL.

An advanced course the elements having been taken in General Metallurgy. Sizing with screens and with hydraulic classifiers. Concentrating with jigs, buddles, tables, and vanners. Magnetic concentration.

Three hours a week, for 17 weeks.

Richard's Ore-Dressing and Concentration is used as a text-book.

II. Ore-Dressing Laboratory. Acting Professor RIDDELL.

Practical work with sizing and concentrating machines. Mill-runs are made, full records being kept, and the products are sampled and assayed.

One day a week, for 17 weeks.

III. Ore-Dressing Investigation. Acting Professor RIDDELL.

Advanced work in the ore-dressing laboratory. It consists in the determination of the relative value of different machines and appliances, and in the working out of the best methods for treating various mixtures of ores and gangues. Work of sufficient importance may be used in a thesis.

One day a week, for 17 weeks.

SURVEYING.

PROFESSOR SMITH.

The instruction in surveying embraces not only the theoretical aspects of the subject, but the practical features in all its various phases. The field practice is extended and thorough. Much more time is given to the field work than is customary. In addition to two afternoons and one whole day during the regular semesters, exceptional opportunities for broad experience are offered during the summer semester, when either special work under the professor in charge and in a regularly organized camp is undertaken, or the men become attached to surveying parties outside of the school.

The work in surveying is not only adapted to the students in the regular engineering courses, but every facility is given to those persons who intend to become surveyors, or who, already having had more or less work in connection with surveying parties, are desirous of obtaining further practice and knowledge of the details of the subject.

While both land surveying, railroad surveying and irrigation surveying are fully and thoroughly taken up, it is on mine surveying that greatest stress is laid. An important course is that of modern topographic and geologic surveying according to the most advanced methods followed in the government bureaus of all civilized nations.

I. General Surveying. Professor SMITH.

The introductory course in Surveying deals with the principles of land-surveying, the instruments used both in the field and in the office, their adjustments and their proper care. The transit, level, solar-compass, and plane-table are discussed in detail and their uses in the various problems of land-, mine-, and hydrographic surveying are illustrated by numerous practical problems and field-exercises.

In the field practice each student becomes thoroughly familiar with the laying out with compass and chain of small land holdings, the survey of urban lots and streets by means of transit and steel-tape, location of mining claims, and similar work. Observations are made on the polar-star for the purpose of determining the true meridian. Latitude and longitude by direct polar observations are determined. Triangulation, both primary and secondary, from a measured base-line is carefully worked out. Measurements are made of mountain heights by triangulation methods. The various methods of topographic mapping are considered in detail.

Three hours a week, lectures, and 13 hours a week field practice, for 17 weeks, first half-year.

Johnson's Theory and Practice of Surveying is made the basis of this work.

II. Railroad Surveying. Professor SMITH.

The railroad surveying occupies the first ten weeks of the semester. Under this heading are discussed the location of a railway under the three natural divisions of Reconnoissance, Preliminary Surveys, and Location Surveys, with the methods and instruments adapted to each. The theory of economy in grades and curves is considered at some length; and the principles of simple and compound curves treated.

Practice is given in locating curves and tangents, levelling, plotting, establishing grades, constructing profiles, cross-sectioning, estimating volumes of fills and cuts, location of piers and bridge abutments, and laying out of switches.

Three hours a week, for 12 weeks (lectures); one day a week field-work, and summer field-work.

The texts followed are Johnson's Theory and Practice of Surveying and Searle's Field Engineering.

III. Irrigation Surveying. Professor SMITH.

Among the subjects exhaustively discussed in the lectures are precipitation and run-off, drainage areas, reservoirs and dams,

function of water, conduits, headworks, distribution systems, measuring and applying water. Particular attention is given to the conditions prevailing in the Southwest. The significance of the national reclamation act and its various bearings upon the development of the country are considered in detail.

The field practice includes contouring a reservoir site, computing storage capacities and volumes of dams, and the locating of canals.

Three hours a week, 5 weeks (lectures), and one day a week field-work.

IV. Mine Surveying. Professor SMITH.

The work consists of lectures, field practice and office work. The field practice embraces both surface location of claims and top-works, and the underground excavations.

In the location of mining claims a complete survey is made for purposes of patenting, in accordance with the requirements of Surveyor General's Office. It includes all the methods followed by United States Deputy Mineral Surveyors. As formerly one of the corps, the professor in charge adds his own extended experience. The law relating to surveyors and the patenting of mining properties is treated in the lectures on Mining Law.

In the underground surveying, particular attention is given to physical difficulties met with and unusual obstacles to be overcome. Among the special topics which are dwelled upon at length are the location of underground stations, connection of surface and subterranean workings through slopes and shafts, graphic methods of keeping notes, preparation of mine-maps by method of co-ordinates, preservation of maps, rectification of drill-holes, and permanent records.

In the field practice several mines of different types are surveyed, full notes taken, and maps made. This work is supplemented by summer practice of still more extended character.

Three hours a week, and field practice one day a week, for 17 weeks.

The text used as a basis is Johnson's Theory and Practice of Surveying.

V. Special Topographic and Geologic Surveying. The PRESIDENT.

The methods are those followed by the National and State geological surveys, and the work is especially adapted to those students who are looking forward to investigations of a public character.

As a foundation for the more strictly geologic work the construction of a suitable topographic base-map is carried out in a practical way. The various methods are considered in detail and the advantages and shortcomings of each under different conditions are discussed and compared. Practice in primary triangulation and secondary triangulation and the filling in of the larger triangles by plane-table methods is made a feature. In putting in the topography the contour method is chiefly adopted, and particular attention given to the morphogenic expression of earth sculpture.

Exceptional opportunity is presented for wide experience in this work. The United States Geological Survey in doing work of this character in the vicinity of Socorro; and the New Mexico Geological Survey is also actively engaged.

Three hours a week, lectures, 17 weeks; field-work arranged.

VI. Summer Field-Work. Professor Smith.

During the summers surveying parties are organized, comprising all undergraduate students and others, for a period of about four weeks The field practice is continuous in the various branches of surveying. These parties camp in localities convenient to their respective lines of work.

The first-year men are assigned a township of land which they sub-divide in accordance with the instructions of the United States Land Office, and make a topographical map by the transit and stadia and plane-table methods. Of the upper-class men the students of Mining Engineering make complete surveys and construct maps of important mines; while the Civil Engineering students locate a railway from 5 to 10 miles in length, according to conditions, and also make complete surveys, maps and estimates for an irrigation system.

Each year students are usually able to secure employment for the summer with regular surveying parties and receive encouragement in this in every way possible.

ENGINEERING.

Professors Smith and Crenshaw.

The general subjects in engineering which are necessary in all courses are here grouped together under a single heading. They form the foundation of all of the several branches along which the student specializes. The illustrations and problems relate largely

to mining and are thoroughly practical in character. They embrace all those phases of the subject with which the student is likely to come first in contact. Experimental work is encouraged and a large number of practical topics are constantly awaiting consideration.

The subject appertains especially to the more strictly mechanical side of the several courses. Importance is attached to the mathematical principles involved in each case. The steam engine comes in for exhaustive treatment. Experimentation and testing receive attention; and this branch of the work will be constantly made more of in the future.

I. Hydraulics and Hydraulic Machinery. Professor Smith.

Theoretical hydraulics, head and pressure velocity and path of a jet; instruments and measurements; practical formulæ; flow of water through orifices, weirs, tubes, pipes and open channels; losses of head, hydraulic gradient; nozzles, river-guaging, dynamic force of water; water-wheels, overshot, breast and undershot; turbines and impulse wheels; pumps, reciprocating and rotary, and pumping machinery.

Two hours a week, for 17 weeks.

Merriman's Treatise on Hydraulics is followed.

II. Stresses in Frame Structures. Professor Smith.

The following topics are discussed in their various aspects: The application of the laws of forces in equilibrium to the computation of the stresses in various kinds of framed structures; the method of moments; the method of resolution of forces; loads on a roof truss; dead-, snow- and wind-loads; changes in length due to changes in temperature; highway bridges; dead loads, moving loads, snow and wind; applications to different forms of truss; railway bridges, dead loads, moving loads; snow, wind and impact; shear and bending moment; double and multiple truss systems; deflection of bridges. Numerous practical problems are presented for solution.

This course is preceded by Analytic Mechanics.

Three hours a week, for 17 weeks. All courses.

Merriman and Jacoby's Roofs and Bridges, Part I, is used for reference.

III. Power and Power Transmission. Professor Smith.

The various sources of power are discussed briefly, steam and other heat engines as the great source of power being considered

in considerable detail; the boiler and furnace with their accessories; the engine with its connections and controlling mechanism.

Lectures are given on the transmission of power by shafting, gearing and compressed air; water-power and electric transmission and distribution of power; various types of electric generators, alternating and direct, and the transmission and transformation of electric energy.

Four hours a week, for 17 weeks.

Hutton's Mechanical Engineering of Power Plants is the main text.

IV. Theory of Construction. Professor Smith.

Practical applications on the principles of stresses in the design and proportioning of the various parts of engineering structures, dams, arches, roofs and bridges.

Special attention is given to designing long columns and to the connections of the members of a structure.

Must be preceded by Stresses in Framed Structures and Graphical Statics.

Two hours a week, for 17 weeks.

Merriman and Jacoby's Roofs and Bridges, Part III, is followed.

V. Mine Construction.

In connection with mining design is a special course of lectures with practical problems bearing on the more strictly mathematical features of mine structures. The course includes the application of the theoretical principles to specific cases. Particular attention is given to the relations of geological structures and formations to the character of mine supports, framing, shafting and all underground supporting.

The work differs from year to year, as special conditions come to the notice of the instructors. Local problems are selected in preference to those only known in distant camps.

One hour a week, for 17 weeks.

VI. Metallurgical Construction. Professor Crenshaw.

The course is chiefly a mathematical treatment of similar problems presented by the work undertaken in the special course in metallurgical design. Lectures and assigned work.

One hour a week, for 17 weeks..

VII. Railway Economics. Professor Smith.

This course presents the economic phases of railway location and construction. The causes which affect the gross receipts of a road,

the cost of construction and the operating expenses are fully discussed, and the relative importance of each considered in detail. True and false economy in construction, and kindred topics are entered into at length.

Three hours a week, for 17 weeks.

Wellington's Economic Theory of Railway Location is used as a reference.

VIII. Municipal Engineering. Professor Smith.

During the first half of a semester are given lectures on the location and construction of rural roads and the laying out and paving of city streets, sewers and drainage; gas and water-pipes and street railways.

This is followed by lectures on sanitary engineering and water supplies; the ultimate disposal of the refuse of towns and cities; the design and construction of sewer systems; sources of water supply, storage, purification and distribution.

Four hours a week, for 17 weeks.

Spalding's Roads and Pavements, and Tolwell's Sewerage and Water Supply, are used as references.

IX. Masonry Construction. Professor Smith.

The lectures treat chiefly of the following subjects:

(1) Materials used in masonry construction, under the heads of stone, brick, lime, cements, wood, iron and steel. Special emphasis is placed upon the geological occurrences of the suitable materials and methods of testing.

(2) Foundations; open trenches, pile foundations, foundations under water, coffer-dams, cribs, pneumatic and other methods.

(3) Dams; brush-cribs, framed timbers, masonry and rock fills.

(4) Retaining walls, bridge abutments and bridge piers.

(5) Culverts, wood, pipe and stone arches.

Three hours a week, for 17 weeks.

X. Contracts and Specifications. Professor Smith.

Lectures on the laws governing contracts and their special applications to engineering construction; approved forms of specifications for various structures.

Two hours a week, for 17 weeks.

Wait's Law of Contracts and numerous standard specifications are used in reference.

XI. Steam Engine Laboratory.

Accompanying the lectures on the steam engine is the practice in the laboratory. The work varies from year to year, and excursions are also taken to plants where special features may be studied.

Time and character of work arranged.

XII. Testing Laboratory.

XIII. Engineering Seminar. Professor LMITH.

The students in civil, mechanical and mining engineering and others interested meet bi-weekly for the discussion of recent notable engineering enterprises. Usually the topic is introduced by a carefully prepared paper on the subject and the details critically passed in review.

XIV. Journal Club. Professor SMITH.

A fortnightly gathering of engineering instructors and students, at which current literature is read and discussed.

DRAUGHTING AND MACHINE DESIGN.

It is expected that during the first year the student will acquire considerable skill in drawing preparatory to the special training of later years. Particular attention is given to free-hand work, at least sufficient to enable the student to readily and rapidly make intelligent sketches of all ordinary objects, simple machines, diagrams of engineering works and geological structures. Continual practice in this branch is encouraged during the daily lectures in all departments. Those students showing special aptitude are given opportunities to extend the work in pen-and-ink and with the brush..

After becoming acquainted with the principles of free-hand, geometrical and mechanical drawing, the student, according to his special line, takes up designing and like work. Much time is spent in practice.

I. Free-hand Drawing.

Pencil-and-pen drawings from various models, study of light and shade, perspective, proportions by making measurements of the object "pencil in hand." Free-hand sketches are made of some simple machines representing the parts in their approximate rela-

tions and showing all important dimensions. Practice in landscape sketching.

Three hours a week throughout the year and lectures.

II. Mechanical Drawing.

This course comprises the drawing of 20 plates in the geometrical representation of objects by isometric and orthographic projections. Objects in various positions are projected orthographically and the relations between the different views are brought out; sections at different positions and the intersections of solids are represented. The principles of linear perspective are discussed and applies to the representation of some simple objects.

Four hours a week throughout the year.

The text used is Tracy's Mechanical Drawing.

III. Plotting Surveys. Professor SMITH.

Each student makes a complete map or plat of the surveys made during the progress of the summer field-work and of all surveys made by him during the school year. Bearings of azimuths of courses are laid off both by protractor and by co-ordinates and errors in closure are discussed and illustrated. In general, areas are computed by latitudes and double meridian distances.

Two hours a week, for 17 weeks.

IV. Topographical Drawing.

The topographical survey made in the summer is plotted, all contour lines, streams, roads, fences and buildings being properly shown. The nature of the soil and vegetation is indicated by the conventional topographical symbols, thus making a complete and accurate map of the area surveyed. In plotting stadia work special attention is given to rapid methods of reducing and plotting inclined stadia readings. The mechanical reproduction of maps to different scales and the evaluation of irregular areas are discussed.

Three hours a week, for 17 weeks, and lectures.

V. Lettering and Titles.

Special practice in lettering and the construction of attractive and appropriate letters for maps and engineering plans. Open to students who have taken preceding courses in draughting.

Four hours a week, 17 weeks.

VI. Graphostatics.

In this course the methods of solving problems relating to forces in equilibrium are considered in detail. These methods are based

upon the representation of forces in amount and direction by straight lines, the properties of force, polygons and equilibrium polygons, moment and shear diagrams. Special attention is given to the application of these methods to the stresses in various framed structures.

Preceded by Analytic Mechanics, II.

Four hours a week, for 17 weeks, lectures and practice.

Merriman and Jacoby's Roofs and Bridges, Part II, is followed.

VII. Machine Design. Professor SMITH.

The work is confined to such problems as a mining engineer is most likely to be confronted with. Lectures and recitations using Unwin's Machine Design, Part I, as a reference, are carried on. Problems in rivetted joints, the use of structural steel and iron for long columns and girders and the use of timber are assigned.

In the draughting room drawings are made of the various parts of air-drills or some other machinery in the department. The main object of this drawing practice is to familiarize the students with shop requirements in regard to such draughts and so that working drawings may become perfectly intelligible. The students are aided in this matter by sets of blue prints which have been presented to the school by leading manufacturers of mining machinery. In the latter part of the course the problems taken up in the lectures are made the subject of the draughting room work.

One hour a week (lectures) and six hours a week in draughting room during the year.

VIII. Engineering Construction.

Comprises draughting room practice in preparing complete working drawings of some of the structures considered in the theory of construction. Detail drawings are made of masonry dams and arches, wooden and metal roof-trusses and girder and truss bridges. Special work in this line will be accepted as a thesis. This course accompanies Theory of Construction.

Four hours a week through the year.

IX. Metallurgical Design.

Some time during the latter part of the general course in metallurgical engineering the student devotes a part of his time to detailed and original plans for a plant for ore treatment. From year to year the conditions vary so that no two persons have the same

work. The designs are based upon the surveys made by the student upon sites especially selected for peculiar conditions presented. The working plans, for the buildings, concentrators, furnaces, etc., are drawn up complete in every respect, the full bill of materials made out and the cost of the several parts and of the whole carefully estimated according to the trade conditions and labor factors existing at the time. In fine, the entire work and all computations are carried out according to the best engineering practice, and with the same care that actual construction operations require.

Six hours a week through the year, 34 weeks.

X. Mining Design.

As in the designing of a metallurgical plant the student takes up a given mine, of which he makes all the proper surveys, plans the top-works, making full working drawings of all buildings, trams, ore-bins, and similar constructions, draws up detailed specifications, bills of materials and full estimates of cost.

If an operating mine happens to be selected for this the entire work is gone over and improvements incorporated, and suggestions made where savings may be made. This work, when further elaborated, will be accepted as a thesis.

Six hours a week through the year.

XI. Topographic Mapping.

A special course in topographic mapping is offered the students wishing to take up the subject in a large way, such as is followed by the governmental bureaus of all civilized nations. The methods of the United States Geological Survey in particular are fully considered and ample field practice afforded. The relations of geologic structure to topographic expression are discussed, numerous practical illustrations explained and examined on the ground. All factors entering into the preparation of an adequate topographic base for exact geologic mapping of rock-masses and the proper representation of geologic structures are viewed in their different aspects. Primary and secondary triangulation and the filling in of the subordinate stations by means of the plane-table are fully explained in the lecture room and practice given in the field.

Students in Mining Geology may select prescribed areas of 25 square miles each in which there is great diversity of surface relief and geologic formations and may be given every opportunity to perform all the work with proper supervision, as a part of a comprehensive scheme for mapping the region, which the School has

begun. For this work full credit is given both on the published maps and in the accompanying printed reports.

Six hours a week, for 17 weeks.

XII. Mechanical Engraving.

A brief course of lectures, with practice in the drawing-room, on the mechanical methods of engraving from drawings, the proper methods of drawing and sketching in pen-and-ink (line-work and for zinc etchings), and by brush (half-tones, photogravures and gelatin reproductions), the retouching of photographs for half-tone reproductions, and similar topics. Special stress is laid on the making of "clean" drawings and the ways to obviate "muddy" effects in the engraving.

Two hours a week, for 17 weeks, and lectures.

MINING.

The instruction in mining is given by means of lectures copiously illustrated by lantern views, by photographs and detailed drawings, by some laboratory work and by field examinations. The latter enter largely into the more practical part of the work. Mine administration and mining law receive quite complete treatment. A fortnightly colloquium is held. Alternating with this bi-weekly is the Journal Club. The entire course is pre-eminently practical in chaiacter, and articulates closely with both the courses in mining engineering and mining geology.

As one of the chief purposes of the School is to prepare men not to be miners, but to be planners of mines and supervisors of mining operations, the strictly business character of the profession is kept constantly before the student. Valuing property, properly reporting propositions for investment, or as something to be let alone, calculating in a careful manner all the factors in the economical operation of a plant, suggesting the best methods of developing a property, are considerations which require many trials before perfectly satisfactory results are secured. This effort is given prominence.

Another important feature which is continually being more and more considered in mining operations is the geology of the mineral deposits, and this subject receives greater attention than usual.

I. Principles of Mining.

In entering upon the study of a profession, of as broad a scope and yet so practical in its nature, as mining, it is deemed necessary

to start with some of the more important details which, when understood, will aid in obtaining a grasp upon the subject as a whole. These are taken up at the very beginning of the course in order that the student may acquire from the first a live and practical interest in mining subjects. Mining literature is made intelligible and visits to mines awaken more than mere curiosity.

With these ideas in view the following subjects are discussed in considerable detail:

Excavation of earth by hand and by means of horse-power and machinery.

Explosives; their varieties, compositions and uses.

Drilling of rock by hand and machinery.,

Blasting.

Tunnelling.

Boring in earth.

Boring in rock, by the European rod system; by the cable tool system; and by the diamond drill and other core drills.

Shaft sinking.

This ground is covered by lectures, which are supplemented by visits to mines in the vicinity and by occasional problems in the form of detailed contracts for the removal of ground which is actually staked out.

Boring operations are going on in the neighborhood during the year.

Three hours a week, for 17 weeks, accompanied by Mining Fieldwork..

Manuscript lecture notes are followed, with frequent reference to Ihlseng's Manual of Mining.

II. Mine Surveys. Professor Smith.

The lectures on Mine Surveys include a brief explanation of the instruments used and their adjustment; the methods of surveying mining claims for patents, according to the requirements of the United States Surveyor General's office; the general plans of surface works; the connecting of these with the underground workings; and the surveying of underground workings. Full illustrations are furnished by large-scale maps of mines, and by models of well known mines.

Considerable collateral reading is required.. The practical fieldwork follows closely the principles laid down in the lectures.

Three hours a week, for 17 weeks. Accompanied by field practice, 12 hours a week, for 12 weeks.

III. Special Mining Methods.

In this course the following topics are treated:

Ore deposits; their classification from a mining standpoint, and their irregularities.

Prospecting and exploration.

Development; and conditions affecting the choice of methods.

Support of excavations by pillars of mineral, timber and rock filling.

Working; and conditions affecting the choice of methods.

Open-pits; salt mining and placer mining are here included.

The primary object of the course is to present, first, the various classes of ore deposits which may be met with and the irregularities which may exist in them, which control their development in working. It is then shown how all of the conditions existing in each individual case, must be weighed *pro* and *con*, in order to select the method which will best satisfy the conditions.

Special problems are submitted which, it is expected, the student will solve.

Two hours a week, for 17 weeks.

IV. Mining Laboratory.

Practice in sharpening, hardening and tempering drills, both hand and machine patterns, in the use of drills, in placing, charging and firing blasts, in the examination and handling of mining tools of all kinds, and mining machinery. As soon as the course of mechanical engineering is thoroughly established in all its branches, the work in the mining laboratory will be materially augmented. Special courses in experimental work will also be inaugurated..

V. Mining Engineering, I.

The treatment of the subject of mining is from the standpoint of the mechanical engineer, special stress being laid upon the following subjects:

Generation of power.

Transmission of power.

Utilization of power in mining, transportation, pumping and ventilation.

As the first and second of the above mentioned divisions are given in detail in a special course, it is to the third that most of the time is devoted.

Under mining; power drills and mechanical coal cutters are considered.

Under transportation; cars, buckets, cages and skips; ropes and rope haulage; hoisting engines, with all their accessories; aerial tramways; loading of ores from docks upon vessels; transportation of oil and water in pipes and flumes.

Under pumping; the Cornish, direct acting and centrifugal pumps.

Under ventilation; the various natural and artifiicial means employed to induce and control air currents.

Aside from the above the construction of foundations for machinery and storage bins and tanks, both underground and on surface are treated.

Three hours a week, for 17 weeks.

VI. Mining Engineering, II.

Continuation of Mining Engineering I.

Two hours a week, for 17 weeks.

VII. Mining Engineering, III.

Under the title of Mining Engineering there was included above (courses V and VI) the mechanical consideration of mining methods. As the mining subjects are here divided, the special course under consideration refers more particularly to that branch of the general course which has for its main object the description of the methods of surveying, exploration and valuation of mining properties.

Each student is required to take some local mine and reduce to paper in the form of a regular report all the information pertaining to topics discussed in the lectures. His further practice, partly in connection with actual expert examinations, is carried on in the course of Mine Examinations.

Three hours a week, 17 weeks, lectures and field-work.

Manuscript notes are followed; copious references are made to the literature of the subject; much collateral reading is expected of the student.

VIII. Mining Field-Work.

By inspection of mining methods followed in the various camps in the neighborhood of the School there is afforded great variety of illustration of the themes developed in the lectures.

The inspections are carried on partly as class-work in company with the instructor in charge, and partly as individual work. Full notes are required to be taken and these are subsequently reduced

in the office to proper form, accompanied by the necessary sketches and plans to make the whole procedure thoroughly intelligible.

Twenty hours a week, for 17 weeks, or its equivalent are required for the proper performance of the work of this course. Accompanies both Principles of Mining, and Mining Engineering. Must be preceded by Principles of Geology, and Types of Ore-Deposits.

IX. Mine Examinations.

The main object sought in this course is to train the student sufficiently in expert mine examination work to enable him to report intelligently upon a mining proposition as to the advisability of purchase, or of operation.

Practice is afforded in making regular reports, complete in every respect, on different kinds of mining properties. Each student is assigned a different mine or property to examine. In case the mine has been reported upon in previous years detailed comparison of the results is afterwards made. A considerable number of reports on mining propositions are made each year by the professors of the School; and it frequently happens that arrangements may be made by which one or more students may accompany these examinations.

Among the more important topics usually considered are the topography of the district, as an index to its accessibility, and outside constructions, the character of the geological formations, the geological structure particularly as affecting the ore bodies, the character and disposition of the ores, the amount of ore in sight, the probable extent of the unexplored part, the best method of extracting the ore, of concentrating it, of preparing it for shipment or treating it immediately for the metal, the water facilities and the facilities for transportation to market. Full computations are required, and estimates of the cost of each process, and of the necessary plant, and each of its various parts.

Twenty hours a week, for 17 weeks, or equivalent time, are recommended.

X. Mine Administration.

In all the transactions of the mining courses particular stress is laid on the business aspects of mining operations. The principles of true economy in every department of mine operation are reiterated again and again. The value of keeping tabulated records of different grades of work, and its cost from day to day, is urged as a means of constantly reducing the fixed charges and of doing away with much of the extraordinary expenditures, without

reducing the efficiency of the work. The devising of methods of increasing the output, with limited working forces is emphasized..

Not only are the subjects of labor in all its various phases, the details of supplies, and the sale of ore prepared for market taken up, but mine accounts, statements of cost and monthly reports are discussed.

Practical talks on various phases of the subject are also given each year by managers of mines.

Two hours a week, for 17 weeks.

XI. Mining Law.

Each year some distinguished attorney is invited to deliver before the School a short course of lectures on mining law, particularly in relation to the manner of locating placer, lode and tunnel claims, on water rights, law of the apex and similar questions.

One hour a week, for 10 weeks.

XII. Special Mining Problems.

The lectures in this course are by specialists on various mining topics. They are given at irregular intervals during the year, as opportunity offers, and are open to all students.

XIII. Mining Seminar.

Fortnightly colloquium held under the direction of the professors and assistants, and open to the more advanced students of mining. Subjects for discussion are the results of work done in the School and the recent advancement made in mining methods.

XIV. Journal Club. Professor SMITH.

Bi-weekly gathering of professors and mining students for the consideration of the current literature of mining.

MINING GEOLOGY.

THE PRESIDENT.

The new department organized for the express purpose of offering a sequence of courses having for its main object the special consideration of the ore-bodies themselves and their relations to geological structures, is founded on the belief that the proper knowledge of this branch of mining contributes equally as much to the success of any enterprise as a knowledge of mechanical mining methods, or what is most generally understood by mining engineering.

In the courses leading up to the degree of E. M. at this institution, the candidate has his choice of emphasizing his general course along three different lines. His bent may be towards the metallurgical side of the subject, towards the mechanical side, or towards the geological side. Each of these facies is put on the same plane. Undoubtedly, the proper geological consideration of the materials sought after in mining vastly promotes mining both generally and specifically by putting each proposition upon a more strictly business basis. Prospecting is more rationally conducted. Exploration is more confidently carried on. Exploitation is systematically productive. The element of chance is very largely eliminated.

As then considered, this subject is really a specialized branch of geology in its broadest sense.

I. Genesis of Ore Deposits. The PRESIDENT.

The instruction in this subject is essentially in the principles of ore deposition. It is inseparably connected with that in the Types of Ore Deposits and in the Mining Industry. The course should be preceded by the Principles of Geology, and if possible by Dynamical Geology, Structural Geology and Stratigraphical Geology; also the Principles of Mining, and Mineralogy. Only in exceptional cases can the elementary geological work of other institutions be accepted as preparation of satisfactory character. In case of the prerequisites as offered in this School, special stress is laid on the practical mining bearings of all the phenomena; and the consideration of these derives its main illustrations from mining districts, where the actual obstacles presented by them to mining operations have been overcome.

The subject is treated by lectures, supplemented by copious references to the literature, and seminar work. Numerous field inspections are necessary; and it is advised that this branch of the work be made as extensive as possible. In addition to the regular class excursions, which take place on Saturdays and in vacation times, individual inspections are recommended. An important part of this work will be succinctly written reports of what has been seen.

Among the main general topics treated of in the lectures are: The distinguishing characters of ores, an outline of the geological terranes, the geological structures especially connected with ores, the geology of ore deposits (as space fillers or geological formations), the conditions governing ore deposition, the character of

ores, the mineralogy of ores, the structural features of ore-bodies, rock alteration and its relation to ore formation, and the classification of ore deposits.

No text-book is used. The outline of the course is obtained from the syllabus. The leading treatises on the subject of ore deposits are constantly consulted. The aim of the course is to give a concise and philosophical view of the foundation of ore exploitation, and modern mining. A number of specific cases out of the total number met with by the student in the course of his inspections are critically tested by the several general theories of ore deposition.

II. Types of Ore Deposits. The PRESIDENT.

In accordance with the scheme of classification adopted the main types of ore deposits are discussed in all their aspects, and illustrations of each given. The subject is approached from the geological view-point. The general plan followed is essentially an arrangement of the geological processes, so far as they affect specifically the ore bodies and their original deposition. The resulting ore classification itself is in terms of the forms of ore bodies as geological formations or terranes, and as dependent upon geological structures. This basis appears to be the only one that is truly genetic in nature, and yet serviceable in ore exploration.

The data for an ore classification of this kind are derived largely from the facts and principles established in the course of the great advancements recently made in the study of the crystalline schists and metamorphic rocks in general, as the result of the application of the microscope.

It is therefore quite essential that something of the principles and methods of microscopical petrography should have been acquired before the subject can be fully appreciated.

The fundamental thought running through the entire course is that the main thing to be sought for in the classification of the ore bodies is a system that is based upon genesis so far as possible, that is practical in application and that will aid in their discovery and development. It is assumed that such a scheme should be made so that the ordinary miner may use it. At the same time, it should not offend the most rigid theorist. This common ground seems to be found by giving due consideration to certain geological principles which have recently been found to have a special bearing upon the deposition of ores themselves.

Comparisons are made between the principal classificatory

schemes, including those of Von Oppel, Werner, Von Cotta, Whitney, Phillips, Von Groeddeck, Posepny and others.

During the various excursions to selected mines opportunity is given students to examine critically the ore bodies and to discuss and determine, each for himself, the method of formation and the type to which each ore body belongs. This being accomplished, the best method of exploitation and the probable extent are considered. The secondary changes which the original ore body has undergone are also studied.

The outline used is Keyes' "Origin and Classification of Ore Deposits." The seminary work is of special importance in this course.

Mining Industries. The PRESIDENT.

The subject is taken up according to the different metals commonly mined. The principal deposits of this country are discussed in all their different aspects and the uses of each, their geological peculiarities, and the special methods of working each are considered. The leading foreign occurrences are also taken up.

A syllabus is followed in the general treatment. Constant reference is made to Kemp's "Ore Deposits of the United States and Canada," Tarr's "Economic Geology of the United States," Fuchs and De Launey's "Traite des Gites Mineraux at Metalliferes," and Von Cotta's "Die Lehre von den Erxlagerstaetten." Frequent references to original sources of information are also made.

The various iron ores are first taken up. These are followed by a consideration of the ores of lead, zinc, silver, gold, and then the rarer and less important metals. The different combinations of these several ores are also described.

The situation of the School is exceptional in affording ready access to many varieties of ore deposits. The geological features of New Mexico are wonderfully lucid. Besides the weekly excursions, opportunity is given during the summer term to make special investigations. A prominent feature of the trips to the mines is a criticism of the manner of mining the ores, and the proposal of improvements. The relations of the ore-bodies to the geological formations and structures are especially emphasized.

The fuels, building materials, and minor mineral industries are reserved for distinct treatment.

IV. Non-Metallic Mineral Deposits. The PRESIDENT.

The subject is treated with much greater fullness than is proportionately devoted to it in the works on economic geology.

The syllabus is supplemented by copious references to the original sources of information. It is assumed that the student already has a working knowledge of the principles of geology, of mineralogy and of the rock-forming minerals.

Instruction is given with special reference to (1) the engineering aspects of the materials, (2) the uses, and (3) the methods of mining and preparing the raw substances for the market.

The fuels are considered with special reference to their values as steam producers, their manner of occurrence and the geological structures determining their accessibility. It is expected that analyses and heat-value tests of various fuels will be made in connection with the courses in Chemistry. New Mexico coals are unusually interesting and instructive. In the laboratory a large number of tests are being continually conducted.

The building stones are not only treated with regard to their physical and chemical properties, but special attention is paid to their microscopical characters. The intrinsic qualities and external conditions affecting the durability of stones used in engineering constructions are gone into in detail. The comparative durability of different kinds of stones is considered both by means of tables and by systematic testing. The means of artificially preserving building stones are described. Methods of quarrying and the use of machinery in quarrying all come in for adequate treatment.

Cement materials, limes and gypsum are especially considered, together with the means adopted for testing them.

Soils, fertilizers and road metals are described as to their geological occurrence and their properties.

Each of the minor mineral substances used in construction or in the arts is given the consideration it deserves.

The laboratory examinations and tests are emphasized somewhat differently, according as the student is in the civil, or mining engineering, or geological courses.

Ample opportunities are offered for field examinations.

V. Field Excursions. The President.

The examinations of ore-deposits take place partly in connection with the general field excursions to the mining districts, which occur weekly, and partly as special inspections by those students following the course in the Geology of Mineral Deposits. Some of the excursions are required of all students taking the lectures on

ore deposits, while others are optional with those not in the general courses on mineral deposits.

A great variety of conditions is afforded by the local deposits, as well as those of the neighboring districts. Several trips to more distant places are undertaken some time during the year, the length and season being dependent upon circumstances. It is hoped that the student will avail himself of every opportunity for independent inspection. On all the regularly scheduled trips the student body is accompanied by one or more of the professors and frequently by some expert particularly familiar with all the details of particular properties. Talks and lectures are given on these trips by the professors in charge.

VI. Summer Field-Work. The President.

This work is undertaken under the supervision of the professor and his assistants. It is designed primarily for those whose major work is in the Geology of Mineral Deposits, but it is open also to students in Mining Engineering, and those in Metallurgy. It is largely individual work; one student taking up one branch of inspection and investigation, and another another. Detailed written reports of each inquiry are required; and the student is encouraged to make them as concise, succinct and officially correct as possible. Often this work may by advantageously combined with engineering inspection, or geological surveying.

It frequently happens that the students spend some part or all of their summers, ordinarily called vacations, in the mines in regular employment. When this is done opportunities are given for the exhaustive study of special problems in engineering construction, mining methods, or the geological relationships, genesis and secondary changes of ore-bodies.

The benefits which the student derives from constant contact with actual operations are such as cannot be obtained in any other way. The special trend of his efforts is suggested in the lecture room and by advice of his instructors. He anticipates, as it were, some of the experience he would otherwise gain only after completing his strictly theoretical training, and often under unfavorable circumstances. Coming in the way that it does it in no way crowds out any essential part of his strictly scientific training.

The character and location of the summer field-work are determined in advance by the professor; and some little special preparation is made before going into the field. Some of the inspection trips may be confined to localities in New Mexico; some extend to

other parts of the great Southwest; others may be to distant places. Accounts of these trips and discussions of their results form an enjoyable and highly instructive part of the proceedings of the engineering societies when the work of the School is again taken up in the autumn. Some of the more important results often form material for publication.

VII. Practical Geology. The PRESIDENT.

The subject matter treated of under the title of Practical Geology is intended primarily for the students in engineering who are not taking the course in mining geology.

The aim is to give a working knowledge of the actual field methods employed in geological inquiry. There are taken up some of the leading criteria of geological discrimination, the foundations of classification, and the manner of working towards the attainment of tangible and definite ends.

The collection of materials and apparatus is only incidentally touched upon. The methods of work in the indoor laboratory are passed by altogether.

The practical analysis of geological phenomena is viewed from the standard of the geological survey. This, in its modern development, embodies the most exact adjustment possible of actual field-work, laboratory examination and comprehensive deduction. Each problem is attacked from a number of different view-points; separate lines of investigation are focused upon every question.

Special stress is placed upon those particular phases of practical field-work in geology which experience and consultation have oftenest shown are those to which greater attention should be paid than is usually the case. They are phases in which nearly all persons entering the field of independent geological inquiry have to be instructed before they are able to accomplish the tasks demanded of them.

Among the various themes discussed are the equipment for field-work, the methods of geological mapping, the determination of rocks and rock-masses, the attitude of rock-masses, the deciphering of original geological structures, the dissection of acquired geological structures, geological classification, investigation of massive crystalline masses, crystalline schists, and the sedementaries, and the application of geological principles to the exploitation of mineral deposits.

The lectures are supplemented by the copious MS. notes of the professor in charge.

VIII. Special Investigations of Ore Deposits. The President.

The work consists largely of individual effort. Students may take up very diverse problems, or several students may consider different aspects of the same problem. Library reading, laboratory examinations and field-work are included. The main object is to make one's self thoroughly acquainted with a piece of work already well done, to go over the same ground carefully, and to prove or disprove the conclusions previously arrived at. New evidence may be introduced and new deductions made. The work may consist of the working out of a single problem or of several, as the time and opportunity permit. The course is essentially preparatory to regular research work..

A large number of subjects are near at hand, so that a wide range of choice is possible. In the course of this work many points untouched upon before come up, and some of them may be elaborated later, forming parts of the original lines of inquiry.

IX. Research Work. The President.

Of all the work of the course original investigation forms a part of which much is made. It is a recognized tenet of the institution that the best results and greatest benefits can be secured only after the individual training has been such as to enable independent investigation to be carried on.

At this time there is great demand for thorough scientific researches concerning ore-deposits. It seems impossible to have very much work of this sort carried on by private enterprise, and it therefore falls to educational institutions and public bureaus to conduct systematic investigations. The work is therefore planned with these conditions in view.

During the period of preparation previous to the time when independent inquiry is taken up with profit many problems will have suggested themselves for solution. If, however, the student has been unable to make any selection of topic for himself, there are always awaiting in the department problems that furnish the desired combination of circumstances.

It is expected that the student from his repetition of work already done, will have acquired considerable practice in the methods and manner of attacking problems of the character necessary to give him an insight into similar investigations of his own.

X. Thesis. The PRESIDENT.

Those students electing the general course in Mining Geology are expected to defend creditably the conclusions drawn from some more or less extended investigation. The theme may be in the nature of an extension of wor kalready begun in the previous years, a special phase suggested during the preliminary researches, or on some entirely new subject, selected by the candidate for a degree, or by his chief instructor. Besides being distinctively a contribution to knowledge, the thesis must show ample evidence of a wide acquaintance with the literature directly bearing upon the theme.

It is expected that the student during the last year of his course will devote at least one-third of his time to the preparation of his thesis. The subject of the thesis must be announced at least one year prior to the time when the student intends to come up for his degree, and be approved by the instructor under whose supervision the work is undertaken. I faccepted, the thesis is required to be printed in standard form; or, if in part, to the extent of at least 20 pages, and 150 copies presented to the School.

XI. History of Opinion on Ore Deposition. The PRESIDENT.

Near the close of the fourth year a short series of lectures is given in which the various views that have been held in regard to the formation of ore-bodies are set forth in detail, and compared. Their influence upon mining and upon scientific thought is dwelt upon at some length. These lectures are given weekly for eight weeks. They are open not only to students taking the course in Mineral Deposits, but to others who wish to attend.

XII. Principles of Ore Deposition.

During the last term of the fourth year the preceding course is followed by a number of weekly lectures on the general principles governing the formation of ore-bodies. Each lecture is given by a specialist who has given particular attention to some particular phases of the subject. The results of his investigation are set forth according to his own manner of presenting the facts and illustrations.

XIII. Seminar. The PRESIDENT.

Bi-weekly, a seminar in mining geology and related branches is held under the direction of the president. A member of the faculty or one or more advanced students presents the results of original work done in connection with the School, or calls attention to the

recent important investigations. In the informal discussion which follows, all take part. As most of the students are engaged during the summer in special work of some kind, the presentations of results at the autumn and winter meetings in particular include a diversity of themes.

The colloquium may be varied from time to time by preparations on assigned topics, in which a student gives the results of special study of the current literature on a chosen topic. He may also incorporate the results of his ow ninvestigations. Independent study and practice in working up a subject are the main objects sought.

GEOLOGY.

PROFESSOR GORDON.

The regular courses aim to give a good grounding for the later work in the same subject, and also the more special work relating to the ore-deposits. For the most part the work in these courses is laid out with reference to the mining aspects of the subject. At the same time, every encouragement is given to those who elect to take up geology with the idea of having their studies lead up to the more advanced work in the subject, to independent investigation and research. In this connection the aim, work, and relations of the Geological Survey to the State are worthy of more than passing mention.

Great importance is attached to the field-work in geology. For this work the facilities offered by the neighborhood are nowhere else surpassed. Throughout the course much is made of the operations of the geological agencies.

I. Principles of Geology. Professor GORDON.

As an introduction to all subsequent work in the several branches of the subject—mining, petrology, mineralogy and engineering—the course is required of all students. The instruction is conducted by means of lectures, recitations, laboratory examinations, and frequent excursions into the field.

An outline of the course is furnished by syllabus, with frequent reference to the principal text-books on geology.

All of the training in geology is arranged with special reference to professional work. There are three main classes of students to which the courses have been particularly adapted. The first class

embraces those whose occupations are to be closely identified with mining. A second class includes those who look forward to employment of a more or less public character, such as is afforded by private, State, and Federal geological surveys. A third class aims to embrace students who expect to follow, in part at least, the pure science of geology, or to be connected with the economic and technical departments of higher educational institutions.

The instruction is designed to familiarize the student with the data of geology. Materals composing the earth, the soils, rocks, minerals, ores, fossils and earth-forms, receive the attention they deserve as fundamental elements. The processes and conditions of geology are considered in their different aspects. The laws and methods of interpretation of phenomena are discussed with considerable detail. The mental operation of observation, generalization, suggestion of hypothesis, formulation of theory, and proof of geological doctrine, are explained and the importance of properly considering them in all scientific work is emphasized.

II. Dynamical Geology. Professor GORDON.

A detailed consideration of the dynamic agencies involved in geotectonic and geographic evolution is given. The general scheme followed is genetic in character, as given in Keyes' "Genetic Classification of Geological Phenomena." The fundamental principle recognized is that the processes and not the products are made the central theme. There is thus always presented the underlying relationship of cause and effect. All products find accurate expression in terms of the agencies.

The agencies affecting rock-masses as a whole are discussed in all their various aspects. Models, photographs, other illustrations, and examinations in the field, all contribute to an understanding of the various phenomena commonly met with. Subterranean waters, the conditions governing their movements, and their capacities for transporting metallic substances in solution are treated in considerable detail. The causes of formation and the phenomena presented by mineral-veins and ore-bodies are given particular attention.

Volcanic activity and the influence of such conditions upon the rocks which come in contact with intruded masses of molten rock are fully described and copiously illustrated by examples drawn from New Mexican localities, and from other easily accessible localities. New Mexico is very rich in phenomena of this kind and the field is practically a virgin one.

III. Structural Geology. Professor GORDON.

Throughout the entire course the mining aspects of the subject are kept constantly in the foreground. The intimate relationships which the structures exhibited by rock-masses bear to the economic deposits associated are especially emphasized.

The simpler phenomena of stratification are fully explained and illustrated. The various processes involved in the formation of the sedimentary rocks and the conditions under which the latter are deposited are described more in detail than was possible under Dynamical Geology. Sedimentation itself is followed in all the various phases of transportation and deposition of land-waste. Discussion of the factors which should guide the interpretation of the sedimentary record, forms an important part of the course.

Joint-planes, tilting of strata, the folding, crumbling and crushing of rock-masses are amply illustrated from New Mexican sources. Cleavage, faulting and the relationships of eruptives are explained. Dikes and mineral-veins are especially dwelt upon.

Collateral reading and interpretation of geological maps constitute an integral part of the work.

IV. Stratigraphical Geology. Professor GORDON.

The main purpose of the course is to enable the student to get a connected idea of the history of the earth. The biotic features of the various periods are illustrated by the most important type forms of life. Practice in determining fossils and in interpreting their character is designed to familiarize the student with the common principles of stratigraphy.

The economic value of fossils is commonly entirely overlooked. Often even a slight acquaintance with the true character of fossils enables the rocks to be read as a printed page. It is one of the best established facts in modern geological science that there is an intimate relation existing between mineral deposits and the surrounding rocks; hence the geological age of the particular beds becomes an important factor in the early attempts to develop new mineral districts. This suggestion again rests upon one of the cardinal principles of geology: that the geological succession of strata is determinable readily by the remains of life contained. Thus, in reality, fossils are labels on the rocks, telling one at a glance the age of the bed he is working, and providing him with the most reliable guides he could possibly secure to direct him to the layers most likely to contain the mineral sought.

The range and geographic distribution of the geological forma-

tions are discussed, and their important local facies described. Their characteristic features in the Rocky Mountain region are dwelt upon in considerable detail. Maps, charts, models and other illustrative materials are critically examined. The construction of geological sections is explained. Actual work along this line is undertaken under the supervision of instructors.

V. Field Excursions. Professor GORDON.

Features illustrating a large variety of geological phenomena are well displayed in the neighborhood of the Schoool. The old Socorro volcano, rising 2,500 feet above the campus, presents many types of rocks, and many structures associated with volcanic districts. Lemitar mountain, six miles away, affords other phenomena of vulcanism. Faulting, folding, jointing and their associated features, are well displayed. The sedimentaries are well represented from the paleozoics to the most recent. The phenomena of erosion, and the development of geographic forms are almost unique. With all these illustrations at the very door of the School the student is never at a loss for something interesting and new.

The excursions are made usually upon Saturdays, and often occupy the whole day. Mines are also visited. Each student is instructed in the art of taking notes, and of making sketches and maps. He subsequently writes out a full, but concise report of his observations, which is critically examined in all its aspects by the instructor in charge. These reports are then talked over in class, and the shortcomings noted and corrected.

VI. Geological Field-Work. Professor GORDON.

While the field-work accompanying the more advanced courses in geology is scheduled for a half-day, weekly throughout the year, it is expected that it will be found more convenient and satisfactory all around to carry it on during the summer term, when the trips may not be interfered with.

The work will be more individual in character than was that of the excursions. Particular attention is given to mapping of topographical features.

Emphasis is laid on the training in methods of field observation and in the interpretation of the results obtained. In this connection instruction is given in all the more modern methods employed in conducting geological surveys. As soon as the student becomes sufficiently proficient in the work of this character he is encouraged to take the study of some specified area or some special topic, as an

introductory to regular work in connection with the Geological Survey.

The specific character of individual work varies with each student according to his inclinations, and the nature of his main course of study.

VII. Special Problems. Professor GORDON.

It is expected that the student has already become more or less familiar with the various districts in the neighborhood of the School. He is encouraged to take up the exhaustive study of some limited area, in conjunction with, or under the guidance of his instructor, or he is given some area or theme that has already been well worked out and the results published, and he is required to repeat the investigation on his own account.

In the first case, the student usually takes up the work in connection with the regularly organized Geological Survey. He conducts his investigation as a part of the general inquiry of that institution. There is a wide range of topics from which to select. Nearly all departments of geology offer problems that are both varied and highly instructive.

In connection with the systematic geological work of the New Mexican region the broader problems are continually growing upon the student and some of these become available for extended and exhaustive original inquiry.

VIII. Research Work. Professor GORDON.

The opportunities and facilities for research work in nearly all the departments of geology are practically so unlimited and the entire field is such a virgin one that it is doubtful whether any other region in the whole country is so inviting as that of New Mexico.

For the study of mountain structure no region surpasses Southwestern United States. The effects of vast erosion, the dry climate, the prodigious faulting and tilting of orographic blocks, all contribute to expose the stratigraphy and structure on a scale not to be comprehended elsewhere on the continent.

Many of the broader philosophical questions which now hold the attention of geologists the world over find ample illustration in New Mexico. Mountain building, epeirogenic movements, isostatic adjustment, vulcanism, land-sculpture, extensive sedimentation far removed from the sea, mineralization of rock-masses, and the genesis of ores, find innumerable phases awaiting careful study.

Mineralogy, petrography and paleontology also offer new fields for profitable research. Although original investigation in the last named department of geology is not as yet offered as a part of the regular work, ample provision for instruction, and every facility and opportunity are extended to those students who wish to carry on work along these lines.

Research work in connection with the School has been so productive that it has occasioned the establishment of a regular official organ for the publication of results.

IX. Experimental Geology. Professor GORDON.

The work consists chiefly of reproducing in the laboratory geological phenomena observed in the field. From year to year the experiments vary. Mountain-structures, rock structures and a large number of other phenomena are formed on a small scale.

The work of Daubree, Reyer, Caddell and Willis is repeated; and their descriptions are followed out carefully.

In many cases the principles of geology are applied to economic problems.

X. History of Geological Science. Professor GORDON.

A connected account is given of the origin and development of modern geological thought, and the influences which have contributed to the evolution of the present tenets of the science.

It is expected that the student will supplement the lectures in this course, largely biographical in treatment, by careful perusal of the literature bearing upon the subject. The main aim of the course is to acquaint the student with the men who made of earth-study a science, with their personalities, their environments, the conditions under which they worked and the difficulties which they encountered.

XI. Geological Philosophy. The PRESIDENT.

The great unsolved problems with which geologists today are wrestling are reviewed and discussed in all their various phases. The rise and growth of the ideas, the names of the men associated, and the present trend of thought upon these subjects are considered. References are made to the best literature on the various aspects of the different topics. The present tendencies of geologic work are concisely summed up.

XII. Methods of Geological Correlation. The President.

The modern conceptions of geological formations or terranes and the means of recognizing them in regions more or less remotely separated geographically are reviewed in considerable detail. Illustrations are drawn from nearby sources whenever possibl. Comparative values of the different correlation methods are considered under diverse conditions. Adoption of different and perfectly independent methods in general correlative work is urged. Any given method may have quite different values in different localities. Marked discrepancies when one method alone is applied may be checked by the readings of other records.

Concrete examples are cited in which the various methods of correlative criteria have been applied and their practical values in field work determined. Correlation by means of similarity of lithologic sequence, by lithologic similarity, by faunal comparison, by orotaxis, and by homogeny, come in for special mention and discussion.

XIII. Geological Surveying. The President.

Part of the training in geological surveying is obtained in pursuance of the more advanced courses in geology and in the study of mineral deposits. In these courses it is expected that the student will have acquired something of the art of making topographic base-maps in which the local facial expression of the earth is recognized as due to the underlying rock-structure, of sketching in the formations, and of intelligently constructing geologic cross-sections.

In the special course the work is taken up in a thoroughly practical way. The student becomes a part of the corps connected with the Geological Survey. He works in conjunction with others towards ends indicated by a general policy such as governs public scientific investigation. The chief aim is the preparation of a way for intelligent guidance in the search for mineral wealth. The constant tendency is towards the commercial aspects of the subject. The organization of a geological survey has many features which may be regarded as peculiarly its own. The public character of the survey and its support as a public institution impose duties upon it that are unknown in private scientific and expert work. Training is not only entered into under new conditions, but the student receives instruction in the administrative and organizing duties of the Survey. As contributing to the success of the organization as a whole, these phases are as fundamentally important

as the more purely scientific efforts. Consideration of many and diverse lines of work is an important element.

Details of survey organization and the character of investigations carried on will be found under the heading of The Geological Survey.

MINERALOGY.

Professor Gordon.

The treatment of both mineralogy and petrography is somewhat different from that which is customary, in that unusual prominence is given the more strictly economic phases of these sciences. Special emphasis is given to acquiring familiarity with a large number of mineral species found in mining regions. A thorough knowledge of the more typical rock species, especially the eruptives, with which many of these minerals occur, is regarded, absolutely indispensable to every student.

In the determination of minerals, students become acquainted with the chief characteristics of the more important varieties occurring in ore deposits and as essential constituents of rock-masses, as well as the associations in which they are likely to be found. This work finds greatest application of those methods to which recourse may be had in the field. To this end the crystal form, the physical properties, and the paragenesis of each mineral become critical criteria. Not only is the student expected to become familiar with the wide range of selected specimens in the collections of the School, but also with the material collected on the field excursions or brought into the laboratory for determination. Every opportunity is given the pupil to test his knowledge in a practical manner.

Weekly quizzes, monthly reviews, and other practical exercises supplement the daily lectures and serve to broaden the student's training, as well as to fix in his memory the various distinctions between mineral species. The relative values of each mineral, both from the standpoint of economic use and its worth foı mineral collections, are clearly and fully set forth.

The microscopical examination of building stones, cements, ores and minerals in rock-masses are all considered from the utilitarian point of view, and in accordance with methods that are especially serviceable to the engineer.

I. Crystallography. Professor GORDON.

The introductory course of mineralogy is prefaced by a thorough treatment of the geometrical forms in which minerals crystalize. Each week there are four lectures, during a period of twelve weeks, and one afternoon each week the projection of crystal forms is carried on, and clinographic projections made of the principal types in the several systems. In addition to this, zone-control and the determination of the indices of unknown planes lying in two or more zones are explained and problems assigned. Exercises in orthographic, clinographic and spherical projections form an essential part of the laboratory work.

The different crystal systems are considered in turn and constant practice in the reading of crystal forms is given by means of a complete collection of wooden and celluloid models and also from specially selected natural crystals. The subjects of twinning, hemihedrism, tetartohedrism, hemimorphism and like topics are considered in detail.

Four hours a week, lectures, and one afternoon, laboratory, for 12 weeks.

Williams' Elements of Crystallography is the text-book used, supplemented by Miers' Mineralogy. Frequent reference is made to Dana, Nauman and Miller; and the symbols used by each are thoroughly studied and used.

II. Physical Mineralogy. Professor GORDON.

Following crystallography is five weeks' work in physical mineralogy. The subjects of hardness, cleavage, color, specific gravity, etching, thermo--electrical properties, optical characters and the like are carefully considered. The special study of the optical properties is further considered in the last half-year, and is a prerequisite for all students of Petrography. Students in Determinative Mineralogy are not required to complete this advanced optical work.

Students contemplating going on with the advanced mineralogical courses are advised to familiarize themselves thoroughly with the workings of the petrographical microscope, and the appearance of minerals in thin section. A syllabus is used, based upon the lecture-notes of the late George Huntington Williams.

Under the head of passage of light from one isotropic medium into another the subjects of reflection, refraction, polarization, dispersion and absorption are discussed, as an introductory to the explanation of the passage of light through anistotrophic media.

The practical determination of crystals by their action on transmitted light is only briefly touched upon at this time, the fuller explanation being given in the introductory course in Petrography.

Four hours a week, and one afternoon laboratory, for 5 weeks.

III. Determinative Mineralogy. Professor GORDON.

This subject is carried on after the completion of the outlined work in Crystallography and Physical Mineralogy. It is, however, begun in the preceding courses and is prefaced by a study of the relations between the properties of minerals. The basis of this work is contained in Miers' Mineralogy, Book III.

Determinative Mineralogy is carried on chiefly by means of lectures during the second half-year, preceded by one lecture a week for the four weeks previous. It is supplemented by blow-pipe analysis conducted two afternoons each week, but the order here is according to Moses and Parsons' Handbook; while the lecture work is according to the chemical composition of minerals after the system most generally adopted. The course begins with the Elements, then the Sulphides, Selenides, Arsenides, Tellurides, and Antimonides, the Sulpho-salts, Haloides, Oxides, Oxygen-salts, Salts of the Organic Acids, and finally the Hydrocarbons, are studied according to the arrangement in Dana's "System of Mineralogy."

Especial emphasis is made of specific characters which will enable the student to identify minerals in the field. Much of historic interest is given in the lectures, and gems and precious stones receive considerable attention. Stress is laid upon the paragenesis of the metal-bearing mineral species. Collateral reading is required on the important species.

Four hours a week, and one afternoon laboratory, for 17 weeks.

IV. Blowpipe Analysis. Professor NOBLE.

The afternoon laboratory work in Blow-pipe Analysis is begun in the middle of the first semester and is continued through the rest of the year. The order of subject matter is that given in Moses and Parsons' Mineralogy, Crystallography and Blow-pipe Analysis, beginning with the ores of iron.

At the completion of each group, tests are given on unknown specimens, and the student is expected to identify these without error. Many of the minerals, described in the daily lectures on Mineralogy, are of necessity here omitted, but all prominent ore-bearing species are fully studied.

Methods of research are fully explained and students are required to determine unknown material submitted to them for examination.

During the laboratory afternoon the previous work of the week is gone over and the student completes this portion of his work before going on to the next subject. The notebooks are submitted at the close of the semester for inspection and are not accepted unless the entire work is satisfactorily written up in the laboratory.

V. Advanced Mineralogy. Professor GORDON.

Work in the second year of mineralogy consists largely of individual effort along lines leading towards original inquiry.

In one direction, a strictly mineralogical study is made of some group of New Mexican minerals. This is a part of a systematic plan of exhaustive treatment of New Mexico mineralogy. Ample opportunity is given through the Geological Survey to obtain good material from many localities. The crystallography is carefully worked out in detail, chemical analyses are furnished through the Chemical Department and all the noteworthy features are recorded. The field-notes are also incorporated. The paragenesis, the geological occurrence, and the economic bearings of the various minerals are considered in all their various aspects.

VI. Mineralogical Laboratory. Professor GORDON.

The mineralogical laboratory is open ten hours daily to all students taking mineralogical courses. In the general laboratory is conducted chiefly the work required in the earlier courses; while the advanced work and researches are carried on in separate smaller rooms.

The required work in crystallography is one afternoon a week, during which crystal models and natural crystals are studied, and practice is had in crystal drawing, crystal projection, and crystal measurement.

In Physical Mineralogy, the laboratory practice requires also one afternoon a week. Examination of thin slices of minerals under the microscope enables the student to become familiar with some of the optical characters of minerals. The work includes testing hardness by the various methods, determining the specific gravity of various kinds of minerals, experimentation in heat, electricity and magetism effects, in etching, and in microchemical reactions.

The advanced work in mineralogy is largely carried on in the

laboratory. It includes also original investigation, and official mineralogical inquiry in connection with the survey of mineral resources.

VII. Microscopical Petrography. Professor GORDON.

The form and physical and chemical properties of the rock-making minerals as shown by the microscope are taken up in order.

The subjects of the separation of rock constituents by means of heavy solutions and the microchemical reactions are entered into with considerable detail. Minerals of the different crystal systems are taken up in turn, and examined first in thin sections of individual crystals and afterwards in mineral aggregates.

Particular attention is paid to the alteration of minerals in rocks, as disclosed by the microscope, for the reason that the subject has such an important bearing upon rock metamorphism in general and the formation of ore-bodies in particular..

Four lectures a week for a half-year, 17 weeks. To be preceded by all the mineralogical courses, except Advanced Mineralogy. Accompanied by laboratory work.

Iddings' translation of Rosenbusch's "Mikroskopische Physiographie der petrographisch wichtigen Mineralien" is the chief manual used in connection with the lectures.

VIII. Petrography of the Igneous Rocks. Professor GORDON.

As a basis for all subsequent petrographical study, the appearances which the igneous rocks present when viewed in thin sections under the microscope are from the first gone into rather exhaustively. The lectures take up the simpler granites and, in order, the rest of the acidic series, then the members of the intermediate series, the basic series and finally the small group of the ultra-basics. With the last mentioned series, the celestial rock-types are briefly treated. The main work in this subject is, however, done in the laboratory.

Three lectures a week, for 17 weeks.

IX. Petrographical Laboratory. Professor GORDON.

The Petrographical Laboratory is open to advanced students, 10 hours each day; and to others taking the petrographical courses during the afternoons.

The microscopes are the large stands manufactured by Reichert, of Vienna, complete with objectives, eye-pieces, triple nose-piece,

and necessary accessories. A rock-slicing machine with power attachment enables the student to prepare thin sections of the rocks which he is studying.

Besides the regular series of thin sections, including those furnished by Krantz, of Bonn, there is a rapidly growing collection of New Mexico crystallines, both in hand specimens and thin sections. In addition there are the collections of the professor in charge, consisting of a large number of European rocks from type localities, and illustrating very completely Rosenbusch's Massigen Gesteine, a suite of Maryland rocks, and a large number of miscellaneous rocks from all parts of the world, mostly representative of described localities.

Opportunity is given by nearby localities for the collection and study of a large variety of igneous rocks, and the attendant geological conditions and structures. The specific bearing of these eruptives on ore-bodies also finds ample illustration. Many of the problems presented afford unsurpassed advantages for original work.

X. Field Work. Professor GORDON.

A number of excursions to the principal mining camps afford excellent opportunity for the collection of mineralogical specimens, and enable the student to become familiar with the occurrence of minerals.

The geological trips also permit collections to be made.

BIOLOGY.

PROFESSOR GORDON.

The biological courses are offered in engineering mainly for two reasons. One is to enable the student to become somewhat familiar with the manipulation of the microscope and the preparation of material for examination, and at the same time to learn something of the minute structures presented by living forms, both animal and plant. The other is in order to enable the student to use the fossil organisms contained in the rocks as a guide geologically to locate himself.

In the first instance, the student is led to the investigation of woods, by means of the microscope, to learn the causes of decay and to suggest means of preserving timbers used in engineering

construction. From mine-props, timbers, piles, railroad ties and the like, exposed more or less to the influence of dampness and water, the study ranges to bridge materials and building frames. This subject has been so little considered by engineering students that important results await him who wishes to bring out highly practical results.

In the second case, the ancient organisms found in the rocks afford an index to the geological age of formations. While the subject of paleontology branches out almost infinitely, there are practical phases of the highest value to the mining engineer. Of all the biotic groups, molluscan shells are probably most frequently met with. To these particular attention is directed.

I. General Biology. Professor GORDON.

The course affords a glimpse of the types of life. The simpler forms and the minute structure of the higher ones is studied by means of the microscope. As the main object is to give the student an idea of the broader distinctions of the main groups of plants and animals, the survey covers with some detail a few forms rather than imperfectly a large number of species. Several hundred finely mounted and carefully selected slides are already available for histological purposes. The subject is introductory to paleontology.

Three hours a week (lectures), and 6 hours a week laboratory work, for 17 weeks.

Text-book: Dodge's Practical Biology.

II. Introductory Paleontology. Professor GORDON.

A brief view of the fossils is taken with special reference to the geological succession in Southwestern United States. Characteristic types of each of the geological periods are studied with care. The methods of determining geological horizons by means of fossils are discussed and allusion made to geological correlations.

Advanced study is offered to those desiring to take the subject as a main theme. The New Mexican field is very inviting. Details and time will be arranged..

Three hours a week for 17 weeks. Prerequisites are General Biology and Principles of Geology.

Zittel and Eastman's Text-book of Paleontology is used, with frequent reference to other manuals and to original sources.

III. Botanical Laboratory. Professor GORDON.

Examination, under the microscope, of fungi and other lower

plant forms which produce decay in timbers. Explanations and informal talks precede the work in the laboratory. Offered to students in civil and mining engineering and others especially interested in the subject of decay of constructional wood, and the methods of its preservation.

Several hundred selected slides of botanical subjects are available for study, besides the material which the student prepares for himself.

IV. Geological Biology. Professor Gordon.

Philosophical consideration of biotic facts and principles as applied to geology.

One hour a week for 17 weeks. Optional.

Williams' Geological Biology is followed.

LANGUAGES.

Professor Drake.

A speaking knowledge of Spanish has recently become a great advantage, if not a necessity, to a large percentage of the young men who engage in any of the lines of work for which they may fit themselves at the School of Mines. For that reason special attention is given to the study of the language at this institution. The course offered continues through four years and is designed to give the student a practical speaking knowledge of Spanish. The location of the New Mexico School of Mines affords an unsurpassed opportunity for acquiring this knowledge, for in Socorro and vicinity Spanish is as generally spoken as English.

The course in German continues through three years. No particular attention is given to the speaking or writing of this language. The student may, however, acquire as much familiarity with conversational German as his inclination and time will permit. The chief aim is to put the student into possession of a useful instrument for his major line of work.

The importance of a reading knowledge of both German and French cannot be emphasized too strongly, as a vast store of information necessary to the engineer and scientist is locked up in these languages. By the end of the second year the student should be able to read readily the scientific and technical books which are of use to him in his work.

The course offered in French continues through two years. The

chief aim in this course, as in the course in German, is to give the student such a reading knowledge of the language as will be of practical use to him in the pursuit of his special line of work. The student is expected to be able at the end of the course to read French with sufficient ease to use French text-books and other publications in the pursuit of his technical studies.

It is a notable and deplorable fact that many college students of excellent standing in their particular lines of work are unable to express themselves creditably in their own language. A two years' advanced course in English is therefore given at this institution in order that every technical student in attendance may acquire an efficient use of what is commonly his only instrument of expression.

The course includes English and American literature, in order that the technical student may not be without some knowledge and appreciation of the best thoughts of his mother tongue. This course is required of students in all departments of the institution.

The reports on mines, surveys, and other work done by the student, in connection with his other work, are critically examined and corrected as to the English employed and the shortcomings in grammar, composition and rhetoric thoroughly discussed in class. This work continues throughout the entire sojourn of the student at the School.

I. Spanish. Professor Drake.

The work is based on Worman's First and Second Spanish Readers. A part of the class exercises each day consists in cross-translations, both oral and written. Special stress is placed upon conversational exercises. Attention is given to the elementary principles of the grammar of the language, especially to conjugation.

Five hours a week throughout the year, 34 weeks.

Worman's First and Second Spanish Readers, and Garner's Spanish Grammar are used as texts

II. Spanish. Professor Drake.

Alarcon's El Capitan Veneno and Valera's El Pajaro Verde are read. The study of Spanish grammar is pursued systematically, Garner's Spanish Grammar being used as a text. Two hours each week are devoted to conversation in Spanish and to cross-translation, no particular text-book being used in this work.

Five hours a week throughout the year, 34 weeks.

III. Spanish. Professor DRAKE.

Galdos's Dona Perfecta and Calderon's El Magico Prodigioso are read in class-room; and other reading is issigned to be done independently of the class-room. The study of composition and advanced grammar is pursued. Exercises in conversation are continued and recitations and lectures are conducted principally in the Spanish language.

Four hours a week, 34 weeks.

IV. Spanish. Professor DRAKE.

The readings consist of selections from Cervantes' Don Quijote, and from modern poets; also of some Spanish periodicals in which are treated subjects in line with the work being done by the particular class taking this course.

Exercises in conversation are still continued, lectures and recitations are conducted in Spanish, and effort is directed to the acquiring of a scientific vocabulary.

Four hours a week, 34 weeks.

V. German. Professor DRAKE.

The first year's work in this course is elementary. It consists of a study of grammar and easy readings. Practice in speaking and writing the language is not insisted upon any further than it may be an aid in fixing the main principles of construction in the mind. However, opportunty to acquire a speaking knowledge of German is afforded to such students as may so desire.

Five hours a week, 34 weeks.

VI. German. Professor DRAKE.

The second year's work in German consists in the reading of narrative and descriptive modern prose and a drama of Lessing or Schiller. The study of Grammar is continued. Sight-reading forms a large part of the exercises of the second term. The reading texts are changed from year to year to avoid repetition and to give students who may desire to do so an opportunity to take more than the required amount of German.

Five hours a week, 34 weeks.

VII. French. Professor DRAKE.

During the third year the work in German is specialized to suit the needs of the particular class of students who may be taking the

course. German scientific text-books and periodicals are read and special attention is given to the acquiring of a scientific vocabulary.

Five hours a week, 34 weeks.

VIII. French. Professor DRAKE.

The first year's work is elementary. Otto's French Conversation Grammar and Le Roman d'un Jeune Homme Pauvre form the basis of the work. The text-book for reading is changed from year to year, however, to give students who may wish it an opportunity to read more than the required amount of French. Easy readings are assigned for work outside the class-room with a view to examination.

Five hours a week, 34 weeks.

IX. French. Profess DRAKE.

Effort is still concentrated upon reading. The student is expected to be able at the end of this course to read with sufficient ease to make practical use of French text-books and periodicals in the prosecution of his other studies. The study of grammar is continued. La Petite Fadette, Le Cid, Le Misanthrope and Athalie are the texts from which the readings are selected.

Five hours a week, 34 weeks.

X. English. Professor DRAKE.

The first year of the regular college work is devoted to a review of the main principles of English grammar and to Rhetoric and Composition. The word is made as thoroughly practical as possible. The chief end sought is to direct the student to the acquiring of accurate and easy expression. The text-books used from year to year are such as seem best suited to the capacity of the class taking the course.

Three hours a week, 34 weeks.

XI. English. Professor DRAKE.

A general course in English literature is offered for the second year in this line of work. Extracts from the writers from Choucer to Tennyson are read and studied as extensively as time will allow. Attention is given to the various groups of English writers and to the historical significance of their works. A course in American literature also is given with the same general plan and purposes in view. Systematic collateral reading is also required as an integral part of the work.

XII. English. Professor DRAKE.

During the third year, the language, construction and choice of words used in the formal reports of the students as a part of the regular work in the several departments of the School are discussed in the class-room. In the first and second years this work is carried on in connection with the regular courses.

DEGREES.

The degree of Bachelor of Science, Mining Engineer and Civil Engineer are conferred upon recommendation of the Faculty. No candidate for a degree may be recommended except after the required examination and a residence at the School of Mines of at least one year.

The degree of Bachelor of Science is offered students who have followed the prescribed courses of college study for a period of not less than three years, the last one of which must have been passed in this Institution. Work done at other colleges may be accepted so far as it may correspond to the work done here, but in each case the Faculty reserves the right to decide whether this previous work has been satisfactory.

In announcing his intention of becoming a candidate for the degree of Bachelor of Science the student should bear in mind that the requirements are essentially those of colleges of good standing where the length of the period of study leading up to the bachelor's degree is four years. The candidate for this degree is admitted to the School of Mines a little in advance of ordinary college requirements. He may also continue his work during two regular summer terms, gaining during each a half school year; or he may extend his study over a period of four years, as he elects. It is expected that the candidate for the bachelor's degree shall proceed to engineer's degree, and it is conferred at the same time.

The degree of Civil Engineer is offered upon terms similar to those requred in the case of the mining engineer, except that the candidate substitutes in some of his later work courses which relate more directly to the profession he expects subsequently to follow.

The degree of Mining Engineer is offered to students who have taken the bachelor's degree at this School, upon pursuing satisfactorily, for a period of at least one year, studies in any one of the general courses in mining engineering, metallurgical engineering or mining geology.

A candidate for the engineer's degree who has not taken all of his college work in this institution, must present sufficient evidence to convince the faculty that he has completed equivalent courses in colleges of good standing, he must be in residence in this School for a period of not less than one year, and he must pass the required examinations. In no case will private study, or study pursued away from libraries, laboratories and the other facilities usually offered by higher educational institutions, be considered equivalent to study pursued in the School of Mines.

In all cases in which any portion of a candidate's time has been passed elsewhere than at this institution, the Faculty shall decide whether the work done is satisfactory, and whether, in those instances in which work has been undertaken outside the School, any period may be considered as passed under favorable conditions and proper guidance.

Formal application to the Faculty must be made by the student desiring to be enrolled as a candidate for a degree. This declaration of his intentions must be made at least one year prior to the time when the student expects to present himself for his examination.

The applicant must fully satisfy several conditions before he is entitled to proceed to the engineer's degree. The entire year previous to his graduation must have been spent by the student at this School; he must have completed in a creditable manner the scheduled sequence of studies; he must have passed the final examinations; and he must have presented a dissertion on some phase of his work, that shall show some marked degree of originality and scholarly attainment, and that shall be acceptable to the Faculty of the School. It is expected that the thesis in each case shall be prepared with sufficient care and exhibit sufficient intrinsic evidences of independent investigation to warrant its publication, in whole or in part.

Names of candidates who, in the opinion of the Faculty, have fulfilled satisfactorily the various requirements of the School, are submitted to the Board of Trustees, and with its approval the degree is publicly conferred, at the regular time of year chosen for that purpose.

FELLOWSHIPS, SCHOLARSHIPS AND PRIZES.

The Fellowships, Scholarships and Prizes of the New Mexico School of Mines are instituted solely for the promotion of scholar-

ship. They are awarded wholly on the basis of proficiency. The essential feature of these honors is to aid men of talent to further achievement in the more purely intellectual pursuits. In bestowing these honors it does not necessarily imply exemption on part of the holders from the payment of fees, though this may be done by special vote of the Board of Trustees.

I. Fellowships.

The system of fellowships was established for the express purpose of encouraging students to continue their studies along broad lines and to devote themselves to the investigative phases of the mining sciences and arts. These fellowships are open to graduates of the New Mexico School of Mines and of other colleges.

In the completed system there is contemplated the establishment of Ordinary Fellowships and Traveling Fellowships.

II. Scholarships.

Through the generosity of the members of the Board of Trustees and others, the New Mexico School of Mines has been able to establish a system of scholarships. Some of these scholarships are open only to residents of New Mexico; in accordance with the regulations hereinafter mentioned, a certain number of other scholarships may be assigned, to students, whether or not the applicants be residents of New Mexico.

These scholarships are awarded annually as honors. The main object sought in the bestowal of these honors is the encouragement of scholarship among those who wish to prosecute studies related to mining in this Institution.

In the awarding of the scholarships the factor of giving financial aid to the student is not taken into consideration, though in any case the pecuniary emolument may be waived for the benefit of others and the name of the scholar still retained on the honor-list.

In order to still further cultivate the spirit of independence in the student upon whom a scholarship may be bestowed, he is expected to assist in some way in connection with the work of the School. The details of this service may vary with the different holders. Whether assistance be in the laboratories, library, or museum, in no case will it be allowed to exceed the equivalent in value of what such services ordinarily demand. Two classes of scholarships have already been provided for.

States Scholarship. Fifty scholarships, each yielding about $100.00 annually, are open to students living in the United States.

They are held for one year. These scholarships are assigned some time during the first semester of each academic year.

There is one scholarship for each state in the Union. The student from each state passing the best examination for entrance to the School, or to advanced standing, or furnishing evidence of best qualifications to carry on the work in this Institution, is awarded the scholarship for that state. State scholarships are bestowed upon the following conditions:

1. The application must be made in writing before May 1 of the academic year preceding that in which the scholarships are awarded.

2. Accompanying the application should be a short statement of the candidate's previous training, and an indication of the course he wishes to pursue.

3. Applicants for the States scholarships are expected to proceed to the engineer's degree.

4. Holders of scholarships are not exempt from laboratory fees.

In case in any one year worthy candidates do not offer themselves from any one state, the Board, at its option, may reserve such appointments, or award them to applicants from other states, preference being given to students who already hold college degrees, or who present evidence of unusual attainments in mining studies.

New Mexican Scholarships. Forty scholarships, each yielding $25.00 a year, are open to students who are actually residents of New Mexico. They are good for one year; and are bestowed at the beginning of each academic year.

These scholarships are awarded to the two students from each county in New Mexico passing the best examinations for entrance, or for advanced admission to the School, or presenting the evidences of best qualifications for carrying on the work of the course selected.

Examinations must be taken at the regular time at the end or at the beginning of the academic year. As in the case of the States Scholarships, the New Mexican Scholarships are bestowed as honors, and as incentives to good work. Holders of scholarships are expected to proceed to a degree.

Allis-Chalmers Scholarship. To one member of each year's graduating class there is offered by the Allis-Chalmers Company, manufacturers of mining and heavy machinery, with large works at Chicago, Milwaukee and Scranton, an opportunity for four

months' study and employment in any of its plants, and an emolument of $150.00.

This scholarship is awarded by the Board of Trustees on the recommendation of the Faculty from those graduates of the year filing application before the 10th of June. The opportunity is an exceptional one to observe and study the building of all kinds of modern mining and metallurgical constructions.

III. Prizes.

Brown Gold Medal. Hon. C. T. Brown, of Socorro, offers annually a gold medal to the student while doing a full year's work has shown the greatest proficiency in the subject of assaying. The medal is publicly awarded at Commencement in June of each year. Last year the medal was received by Mr. William E. Hult, of San Antonio, New Mexico.

PUBLICATIONS OF THE SCHOOL.

The School of Mines Press issues a number of publications. These include the Annual Report of the President, the Annual Register, the Department Circulars, and the Reports of the Geological Survey.

1. Annual Report.

The president's report to the Board of Trustees is issued at the close of each academic year. It reviews in considerable detail the work of the School for the year, formulates the plans for the ensuing sessions, and sums up the progress of the School in general. It may also contain the commencement address, and brief mention of notable lectures delivered at the School during the year.

2. Annual Register.

The yearly catalogue contains lists of the officers and students; complete statements regarding the courses of instruction; the regulations and work of the institution; accounts of the laboratories, buildings, equipment, libraries and museums; and all information of a general character regarding the School. It is issued at the close of the academic year.

3. Department Bulletins.

These are issued at irregular intervals during the year, as occa-

sion demands. They are numbered consecutively. The matter contained relates specifically to the details of the work in the various departments of the School; synopses of public lectures and addresses; and all miscellaneous announcements and statements.

4. Reports of the Geological Survey.

The geological department of the School has been for some time engaged in collecting data for a geological, mineral and mining map of New Mexico, and in gathering materials for an exhaustive account of the mineral resources of the region. A large amount of reliable information has already been obtained. A preliminary geological map will soon be ready to issue.

Detailed reports on the mineral industries, the mining methods, and the economic resources are contemplated. A report on the coal deposits is already well along and will be ready for publication in the near future. A volume on constructional materials has been started. Notes on the various mining districts, the occurrence and distribution of the ores, and the best manner of treating the ores, are beginning to assume large proportions. The reports of this series will be issued at regular intervals, as opportunity and the completion of the various lines of work will permit. It is expected that the first report will be printed and ready for distribution during the coming year.

WORK OF THE SUMMER TERM.

A "Summer School" in the ordinary meaning of this term, is not held at the School of Mines. As may be noted by reference to the Calendar, the academic year is divided into two semesters of seventeen weeks each. The summer term of sixteen weeks counts as a full half-year. While no regular lecture courses may be given during this session, the work of the school goes on under the direction of a committee of the Faculty.

For the summer term is reserved all such work as demands much time, uninterrupted by diversions. Among the courses that are best carrried on at this time are ore-dressing, various metallurgical processes, assaying, railroad, land, and mine-surveying, mine inspection, certain phases of design, engineering experimentation, geological field-work, and thesis work. Certain courses in draughting, certain laboratory work, and mapping may also be advantageously engaged in.

Not all of the work of the character mentioned need be done under the direct supervision of the instructor in charge. Nor is it necessary that some of the more advanced phases of it be done altogether in this institution. Work may be done outside with the advice of the professor under whom the course is usually conducted, and he need be consulted only so often as he may think advisable. These are cases in which the student attaches himself to some regular railroad corps, to some reducing works, or to the field party of a topographical, hydrographic or geological survey, when such work comes directly in line of his regular work.

In surveying and engineering, advanced men have in the past found ready employment in various capacities, not only getting a good drill in actual practice, but good pay for their services. Demands for capable men for each season usually exceed the supply. There is every reason to believe that in the future the call for properly trained men will increase rather than diminish.

While in the metallurgical work no positions in the various smelting works have been opened in the past, it is expected that ample provision will be made hereafter for willing students, whereby they may obtain a varied experience and at the same time receive adequate compensation for their efforts.

The outlook for the coming season is that a limited number of men may be taken on the geographical or topographical surveys.

Faithful accomplishment of field duty during the summer term enables a student to add a half-year's work to his credit in the regular courses of the School.

In pursuing the regular professional summer work in the field, whether for surveying, mining, or geologic mapping, a camp is established at some convenient place and the work carried on systematically day after day, in regular fashion, until satisfactorily completed, when the camp is moved to another advantageous locality. The different camps may be adjacent or far removed from one another. Moreover, the kinds of effort expended at the various camps may be wholly different. One of the main objects is to give the student as broad and as varied an experience as possible. By these courses, the student is given far greater opportunities for extended and continued field practice than he is possibly able to have during the other portions of the year. The expense attached to the work of the summer term is usually no greater than for either the first or second semesters.

In a similar manner the professional work in the summer term is conducted in mining and metallurgy. A party of students and

their instructors organizes itself and lays out the plans for visiting the various mining camps, mills, reducing works, or other localities of special geologic interest. After the party establishes itself in a particular district, systematic studies of all the details connected with mining methods, the manner of laying out mines, the underground surveys, and the treatment of the ores are taken up in turn, before passing on to another district. The same general scheme of practical instruction is followed in the case of the sojourns at smelting works, and in the field especially visited for the geological features presented.

Special stress is laid upon the proper keeping of notes. These are fully written up each day. They are made use of later as a basis of other work in connection with the regular courses. Besides, if carefully kept, they prove valuable references in later years.

It may be, and in all likelihood will often happen, that the summer field parties in mining, metallurgy and geology, will not be kept intact as a single organization, but that there will be formed three entirely distinct groups, each having widely different fields of action.

The details of the summer work are given in special bulletins several weeks before the close of the second semester.

FIELD EXCURSIONS.

In the New Mexico School of Mines much is made of the experience obtained beyond the confines of the compus. This practical work forms a necessary branch of a liberal training. Every student is urged to take copious notes of his observations on the topics in hand. His examinations cover this part of his laboratory experimentations.

In addition to the long summer experiences in the field elsewhere mentioned, one day each week, usually Saturday, is set aside for the visits to neighboring smelting works, engineering constructions, machine shops, mineral localities, and places of special geological interest.

In the Socorro Mountains the famous silver mines are visited. The Magdalena Mountains contain the extensive silver-lead mines of the Magdalena and Kelly camps, the newly opened gold mines of Cat Mountain, and the copper, gold and silver mines of Timber

Peak. Immense iron deposits are found in the Oscura Mountains to the east. South of Socorro a few miles are large coal mines. Within easy reach for a day's trip and examination are a large number of other extensive mines of nearly every description.

Of the smelting and refining works, the Graphic smelter at Magdalena, the San Pedro smelter east of Albuquerque, and the Cerrillos smelter, at Los Cerrillos, are frequently visited; while the refining works of Silver City, Deming and El Paso are particularly interesting..

The machine shops of the Atchison, Topeka and Santa Fe railroad at San Marcial and at Albuquerque, the great bridges at these points and at El Paso, and many other constructions of engineering interest are studied in considerable detail.

In the immediate neighborhood of Socorro is a remarkably complete sequence of sedimentary formations, and a large variety of volcanics. Phenomena of rock-morphism and mineralization abound. Vein-structure, faulting, folding, and other structures accompanying mountain-building, are everywhere admirably illustrated.

On all of these excursions the student is constantly impressed with the necessity of systematically taking full notes of his observations, accompanied by suitable sketches, out-line maps, and drawings of important details.

SOCIETIES.

There are a number of organizations in connection with the School of Mines which have for their object the presentation and discussion of technical papers. These societies hold regular meetings, and are open to the public. The membership of these societies includes the professors, assistants, advanced students and elected professsional men of New Mexico. Lectures by professional men and alumni of the School are provided for during the year.

Engineering Society.

This society is organized to meet monthly. At each session a formal paper is presented on some notable project in mining, metallurgical, civil, mechanical or electrical engineering. A discussion follows, in which all members take part.

Scientific Association.

Holding sessions monthly, the scientific association includes among its membership all those persons who wish to avail themselves of the opportunity to attend lectures or the reading of papers on subjects of broad scientific interest. The discussion following may be taken part in by all members. At least once a year some eminent scientist is invited to give a lecture under the auspices of the organization.

Mining Club.

Organized partly for intellectual improvement and partly to promote sociability among students and professors, the mining club meets fortnightly.

Other bodies of students and professors hold weekly meetings in the laboratories for the reading and discussion of engineering and technical journals. In the several departments of the School seminaries are also held.

University Club.

The University Club has been organized for the purpose of promoting social and intellectual intercourse among college graduates connected with the School of Mines or residing in Socorro. During the past year over 30 persons were eligible to membership in the organization.

Among the main objects which are kept in mind are the bringing together of college and university influences from widely different quarters of the country through the representatives of the various institutions now living in Socorro, the promotion of higher education in New Mexico and the endeavor to keep the members of the club in touch with modern university spirit and life in the different parts of the world.

At the beginning of last year a large dwelling, pleasantly situated, was leased and made the home of the club. A well-appointed reading-room was fitted up and supplied with the current periodicals and daily newspapers.

Regular meetings were held fortnightly, at which time it was the endeavor to have some university man of prominence address the members on important university topics of the day. This informal lecture is usually followed by a social time.

LIBRARIES.

The libraries of the New Mexico School of Mines consist of a general library and department libraries.

In the main library are the works of reference, the encyclopedias, dictionaries, journals, magazines, proceedings of the learned societies, laboratory publications, periodical issues of other colleges, reports of Federal, State and Foreign surveys, official maps, plats and atlases, a complete set of the publications of the School, and volumes on history, travel and philosophy.

Libraries are located in the several departments of the School. These are essentially working libraries. They consist of carefully chosen treatises, text-books, monographs, special contributions, and authors' separates, pertaining to the respective divisions. Each department is under the direct supervision of the professor in charge, and is open under certain regulations at all reasonable times.

The general library is in charge of the librarian, who also supervises the purchase of books, the cataloguing of all the books, the issuing of those works not withheld from general circulation, directs the distribution of the School publications, and arranges for the exchanges. The librarian also is in charge of the general reading-room, where the current periodical literature is to be found upon convenient tables..

The libraries are growing rapidly. During the past year many valuable additions have been made, including some complete sets of publications of technical institutions. Addditional book-cases have been installed. An entire re-arrangement of the books is going on. An elaborate and elastic scheme of cataloging on the card system has been devised, so that the libraries will be thoroughly adapted, not only for reference, but as working libraries.

Every effort is being made to make the files of the various technical journals, the transaction of engineering societies and the scientific periodicals as full as possible.

Powell Library. The School has recently come into possession of the private library of the late Major John W. Powell, of Washington, D. C., who for many years was director of the United States Geological Survey. The collection embraces several thousand titles. The volumes are chiefly works on mining, geology and philosophy, many of which are rare, and all are of great practical value. Especially well represented is the literature relating to the

Rocky Mountain region and the great Southwest. It was in these fields that Major Powell did most of his work, which has had such an important influence on the development of the mining industry. It therefore seems particularly fitting that the library of this famous man, who had been so long identified with this western country, should find a permanent home in New Mexico.

The private libraries of the professors are available to advanced students. So soon as suitable arrangements can be made and proper space allotted to it, it is expected that the President's private library, consisting of upwards of 2,000 bound volumes, and upwards of 3,000 pamphlets and authors' reprints, chiefly on the subjects of mining, geology and mineralogy, will be made accessible to students engaged in advanced work and original investigation.

MINING MUSEUM.

A rather comprehensive plan for a complete museum of mining has been formulated. It includes a separate, fire-proof building especially adapted to museum purposes, with large display halls on the first and second floors, around which are arranged smaller rooms for special collections, and for research work, and with work-rooms and store-rooms in the basement.

The collections will aim to illustrate as fully as possible the following departments: Ores and ore-genesis, constructional materials, rocks and minerals, geological structures, models of mines, mining engineering constructions, materials illustrating the history of mining, metallurgical products, the mineral resources of New Mexico and the Southwestern United States, and models of mining machinery. Accompanying these exhibits will be a full series of maps, charts, plans and photographs as further illustrations.

Temporarily the collections of ores, rocks, minerals and other illustrative material are housed in the east wing of the Chemical building.. The scheme is to exhibit as completely as possible:

(1) Mineral resources of New Mexico.

(2) Natural resources of Southwestern United States.

(3) Typical mineral deposits of North America.

(4) Selected mineral examples from the classic localities of the world.

The collections are divided into (*a*) an exhibition series, which is arrarnged in glass display cases, and (*b*) study series, which are

EXHIBIT OF RARE ORES AND MINERALS AT ST. LOUIS

placed chiefly in tiers of shallow trays. Of necessity by far the greater portion of the specimens are not for public display.

In addition, the collections of the President will be soon accesssible to the advanced student. These consist of a small but carefully selected series of crystals, collections of crystalline rocks, chiefly from the type-localities of Europe and this country, and working suites of fossils, illustrating structures and the types of life from all the various geological formations, both American and European, these being especially rich in crinoids, which number upwards of 2,500 specimens.

MINERAL EXHIBIT AT ST. LOUIS.

The major part of the New Mexico mineral exhibit at the Louisiana Purchase Exposition at St. Louis consisted of the collections prepared by the School of Mines. The display occupied a prominent place near the center of the Palace of Mines and Metallurgy. As the only exhibit of the kind made by a mining school it attracted wide attention.

The display was planned to center around a large colored relief model of New Mexico on a scale of half an inch to the mile—or nearly 20 feet square. On this model was shown all the mineral resources. It was accompanied by a large colored section of the geological formations.

Arranged in a score or more of large glass cases were the leading mineral products of New Mexico, selected with special care as to value and beauty. Included were a number of cases of remarkably rare and showy zinc and copper minerals and ores. A special series consisted of zinc carbonate minerals, which for variety, delicacy of coloration and beauty have never been surpassed. Two immense pyramids of showy crystalline ores were embraced in the display.

Four large special collections were of particular interest. These consisted of (1) the largest variety of zinc and copper minerals and ores from a single locality; (2) a collection of rare zinc and copper ores; (3) a unique collection of showy crystals of zinc and copper minerals; and (4) a complete smelting proposition from a single mine.

For these displays and several others gold and silver medals were awarded.

All the collections have been returned to Socorro and now form a prominent feature in the mining museum of the School of Mines.

CHEMICAL LABORATORY BASEMENT FLOOR PLAN

NEW CHEMICAL LABORATORY.

BUILDINGS AND GROUNDS.

The Campus.

The School of Mines campus is situated on the northwest edge of Socorro. It contains 20 acres of nearly level ground within the irrigable belt. Groves of trees have been planted; and trees line the walks and drives.

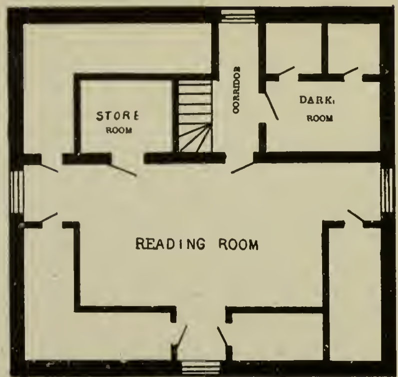
Chemical Laboratory.

The chemical laboratory is a building of two stories and high basement. It is constructed in a very substantial manner of a beautiful gray granite, in broken ashler, trimmed with Arizona red sandstone. It is well ventilated, and has all modern conveniences, being piped for water, lighted by gas, and heated by a good hot-water system. Throughout, the building is handsomely finished in oiled hard woods.

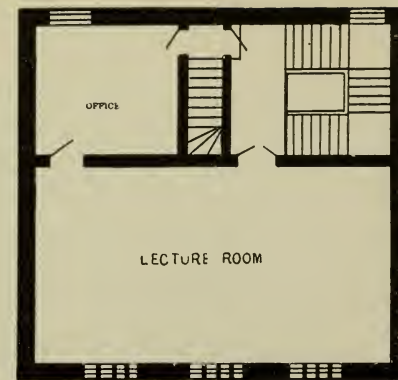
The building is T-shaped, 135 feet long by 100 feet, the central rear wing being 54 by 32 feet. The plans and specifications of the chemical laboratory were drawn by Messrs. Thayer and Robinson, architects, of New York City. These plans represent the most modern requirements of a technical school, as developed by the leading universities of the United States. As now arranged, the main floor of the chemical laboratory contains the laboratory of qualitative analysis, which is to occupy the entire north wing of the building; the quantitative laboratory, taking up the whole south wing; the laboratory for advanced work, the balance rooms, lecture hall, general and private offices of the professor and director of the laboratories, and office of the assistant professor are also provided for.

In the high basement story the arrangement is for a laboratory of general experimental chemistry occupying the whole of the south wing; the laboratory for blow-pipe analysis, the mineral and apparatus supply-rooms, and lavatories are in the north wing; an instructor's office, acid-room and chemical supply-room in the center; a lecture-room, boiler-room and general storage rooms in the west wing.

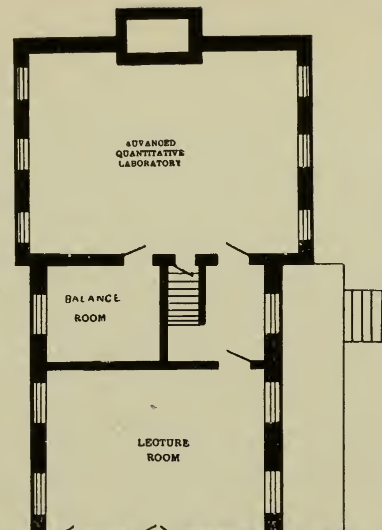
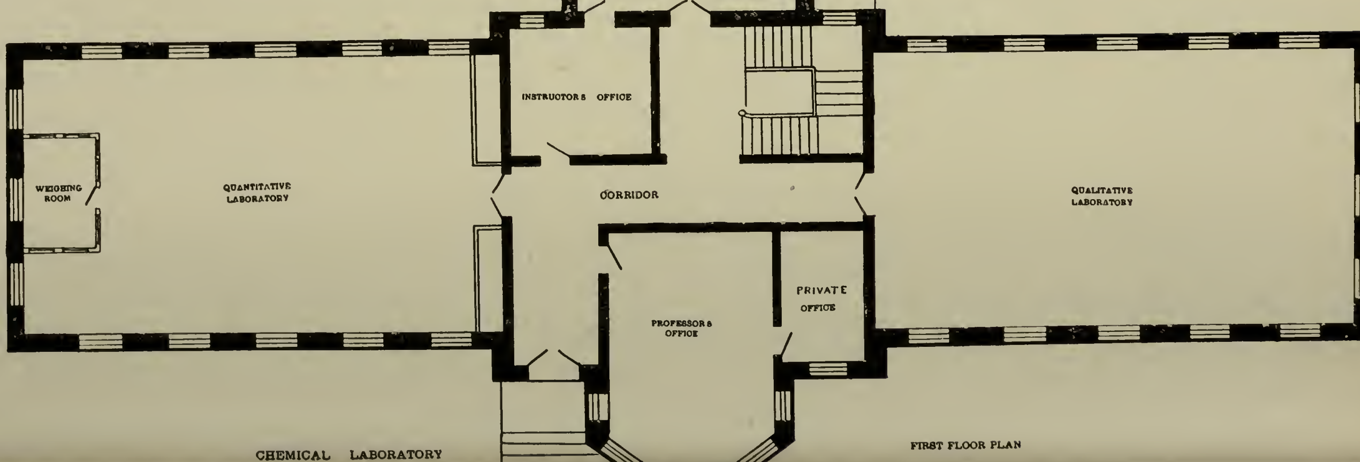
The second story is divided into a lecture hall, a preparatory room, and large hall and stairways. In the third story is a large reading and lecture-room, well-lighted on three sides, supply-room, dark-room for photography and spectroscopic analysis, and a number of deep storage closets.



PAVILION PLAN



SECOND FLOOR PLAN

CHEMICAL LABORATORY

FIRST FLOOR PLAN

A statement of the equipment of these laboratories will be found elsewhere.

Enginneering Hall.

The south wing of this building has already been erected. It is built of Socorro cream brick with gray trachyte trimmings.

The building is X-shaped, as planned for completion after designs by E. B. Cristy, architect of Albuquerque. The central pavilion is two stories, while the four wings are one story. It is peculiarly adapted to the convenience of engineering instruction. The features of the whole design are the spacious rooms.

When the building is completed the entire north wing will be devoted to draughting purposes, the light coming from above. At present the main draughting-room is in the south wing, which also is a lecture-room. Off of this are the Professor's office, and the blue-print room. A photographic room is fitted up in the Chemical building. The instrument room, supply-room and storage-rooms are also located temporarily in the same building.

EQUIPMENT.

Details of the scientific apparatus, metallurgical equipment and mining machinery in the several departments of the school cannot be listed in this place. The practical training which is made much of in this institution necessitates ample laboratory facilities and extensive modern machinery. But the policy which the School follows calls for more than the usual facilities of ordinary laboratories. Part of the practice is on a regular commercial scale, and for this purpose the School is especially well prepared in the Rio Grande Smelting Works.

Chemical Laboratories.

Very complete in its equipment, it is believed that the chemical laboratories of the New Mexico School of Mines rank among the best in the country.

Besides being supplied with large balance-rooms, evaporation hoods, and special tables, the laboratories are equipped with desks, six by two and one-half feet and thirty-eight inches high. Each desk has a cupboard on one side and a tier of five drawers on the other, all under Yale locks. There are water and gas connections, sink, and shelves for reagents with each desk. Every student in chemistry is supplied with a complete set of reagents and all apparatus for the work to be undertaken. Kipp's generators have

been provided for, while the balance-room is supplied with qualitative and quantitative balances of Becker's finest construction.

The chemical lecture-rooms have ample seating capacity. Each is provided with standard lecture-room chairs, especially adapted to student's convenience in taking notes. The professors' lecture-tables extend entirely across one end of the rooms, and are fitted with numerous water and gas connections, and large sinks. When fully manned, the chemical laboratories will accommodate 100 persons at one time.

Blowpipc Laboratory.

The blow-pipe room is fitted up for both mineralogical practice and assaying by means of the blow-pipe. Each desk is supplied with the proper gas connections, reagents, and fluxes and complete set of apparatus. Immediately off the laboratory is the store-room, in which are kept ample supplies of minerals, ores and other material for practice.

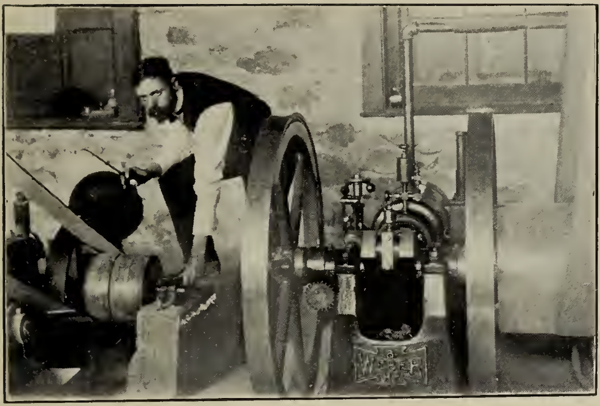
Assay Laboratory.

The assaying laboratory occupies temporarily the main floor and basement of the west wing of the chemical building. The furnaces are all new and include muffle gasoline blow-pipe furnaces of different types, and large muffle coke-furnaces. This department is conveniently arranged with shelving, drawers and boxing for fluxes and other assaying materials and supplies.

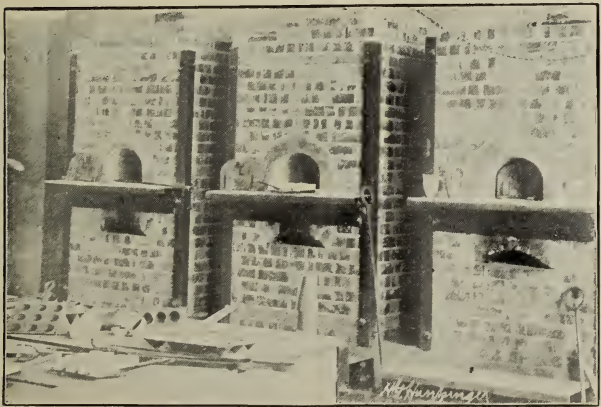
A weighing-room, containing a number of Becker's balances, is conveniently located between the furnace-room and lecture-room. In the grinding-rooms, which are in the basement, is an 8-horse-power gasoline engine of the Weber type, which runs the Dodge ore crusher, a Bolthoff sample-grinder, and will supply power through a line of shafting to other machines. There are also a Bosworth laboratory crusher, bucking-board, mullers and other necessary apparatus.

Petrogrophical Laboratory.

For the microscopic study of rocks, both in elementary and advanced or graduate work, the School is well supplied with microscopes and other necessary apparatus. There has recently been added to the equipment a new style large microscope, manufactured especially for this institution by Reichert, of Vienna. It is constructed especially for obtaining fine results in microphotographic work. The stand includes a Continental Model substage



GRINDING ROOM IN ASSAY LABORATORY.



CORNER OF ASSAY LABORATORY—MUFFLE-FURNACES.

with rack and pinion, an Abbe substage condenser, with iris diaphragm, plane and concave universal mirror, triple nose-piece, and a full set of objectives and eye-pieces. Among the accessories are a micrometer eye-piece, compensating eye-piece, polarizing apparatus, stage-micrometer, drawing apparatus, quartz-wedge, quarter-undulating mica-plate, and other necessary pieces.

Among the series of thin-slices of rocks are a collection of types of the massive crystallines of Europe, prepared by Krantz of Bonn, and completely illustrating Zirkel, sets of Maryland massives, and other American rocks and minerals. The Sturtz collection of European rocks illustrating Rosenbusch, and large miscellaneous collections are expected to be soon available for study.

A rapidly growing collection of typical igneous rocks and crystalline schists of New Mexico, will afford material for thin-slice, obtained chiefly in connection with systematic investigations that are now being carried on.

Engineering Department.

For land, railroad and mine surveying, the department has full sets of instruments, including transits, levels, poles, leveling rods, chains, pins, steel-tapes, hand-levels, compasses and clinometers.

The department has lately added to its equipment a fine large engineer's transit and all accessories, manufactured expressly for this institution, after improved designs by the Gurleys, of Troy. There is included an extension tripod, auxilary telescope, reflector, gradienter attachment, diagonal prism, and solar apparatus..

Draughting Rooms.

A spacious, well-lighted draughting-room is provided in the Engineering building. Opening off of it are the professor's office, supply-rooms, blue-print room, with large printing frame on steel track, developing vat and drying rack.

Drawing tables are furnished each student. There are private spaces for his materials and instruments. Provision is also made for models and illustrative materials.

The photographic rooms are located in the Chemical building.

COMMERCIAL ASSAYING AND TESTING WORKS.

The wide demand which exists in the great mining district of the Southwest for disinterested and scientific tests and practical investigations has led to the establishment, by the New Mexico

School of Mines, of a bureau for conducting all kinds of commercial work relating to mining and metallurgy. For this service the exceptional facilities of the various laboratories of the School and the extensive and practical experience of the instructors are freely offered. A reasonable charge is made for all assays, chemical analysis and other tests. While the pecuniary consideration cannot be entirely overlooked, great stress is placed upon excellence of work and exactness of results.

The expert character of instructors guarantees accuracy of the tests placed in their charge, and the special equipment of the School is such that few private assay offices and ore-treating plants can accomplish so satisfactorily the work even if undertaken. The rapidly increasing amount of this work intrusted to the School is sufficient evidence in itself that the plan has been long needed to further the development of the mineral resources of the region.

The value of work is fully appreciated by successful mine owners and engineers in charge of properties. Probably no feature of the mining industry is more important that the avoidance of costly mistakes. There is nothing which more quickly brings a mining camp into bad repute than idle plants and deserted mines. Prospective investors wish first of all to be shown activity. In most cases of dead camps the idleness is not so much the fault of the district as it is the lack of recognition of the proper and most economical treatment of the ores.

A special act of the Legislature makes provision for carrying on commercial testing. The section from the law governing the School of Mines, Chapter 138, Section 38, Acts of 1889, reads: "The Board of Trustees shall require such compensation for all assays, analyses, mill-tests, or other services performed by said institution as it may deem reasonable, and same shall be collected and paid into the treasury of the School of Mines." All moneys received from this source are used for the betterment of the laboratories.

A special circular is issued, giving the schedule of charges, other necessary information and methods of preparing and shipping samples. Copies are mailed on application. By special resolution it is required that all charges shall be paid in advance.

Commercial Assaying. The assaying for gold, silver, copper, lead, zinc and the common metals, is carried on in all its various phases. The charges are about the same as everywhere prevalent. All work is run in duplicate and in case of any nonconcordant results such assay is repeated. On charges on assays for mining

companies amounting to $50.00 a month, a special discount is given. Particular attention is given to umpire work.

Assays for the rarer metals, as uranium, vanadium, nickel, cobalt, and the like, are made under specially favorable conditions which insure great accuracy. Lime, silica, iron, alumina, and manganese determinations are made according to improved methods and at rates considerably below the customary charges.

Experimental Tests on Ore-Treatment. Accurate laboratory tests are carried on in order to determine the most approved method of treating complex and difficult ores. The scope of this work is continually enlarging. So soon as the Rio Grande Smelting Works comes into full operation, it is expected that eventually every known method and every kind of machine will be in readiness to run practical working tests up to mill-runs of 100 tons. This work is done under expert supervision, with no predilection for method or machine. In this way unbiased results are obtained and the latest and most economical way of treating each kind of ore secured. If they so desire miners or operators may accompany samples and observe the various processes involved, thus familiarizing themselves with the knowledge of skilled manipulators of ore dressing machinery.

Cyanide Process. There has been recently erected by the School of Mines a complete experimental cyanide plant after special and improved designs. Practical working tests in large or small quantities of ores and tailings by the cyanide process may be made. This plant is very compactly and conveniently arranged and will treat lots up to five tons. A large plant of similar character is also planned for more extensive work.

All known processes of leachings are also amply prepared for, including especially Chlorination and the Theosulphate methods. Quantities of ores or tailings up to one ton are treated.

Metallurgical Methods. Full facilities are provided for laboratory experimentation of the proper metallurgical treatment of specific ores. Plans are nearly completed for making tests of this kind on a commercial scale.

Free Determination of Minerals. It has been the custom of the School to gratuitously make determinations of the nature of all minerals and rare ores from New Mexico, provided that a complete chemical analysis or assay is not required. Similar substances from other states will be determined in the same way when not interfering with the regular work of the laboratories. Tests for the com-

mon metals must of course be regarded as assays and as coming under the rules governing such.

The name of the locality where the mineral was found and of the mining claim should be given in order that it may be made a matter of record for enabling the value and distribution of the mineral wealth of the Southwest to be better understood.

Water Analysis. The chemical analysis of waters for city-water supplies, boilers, and domestic use and of mineral and mine-waters has of late assumed great importance. The chemical laboratories of the School are fully equipped and in the case of bad waters suggest remedies and methods to be used to improve the waters for specific purposes. A large number of analyses of waters from the Southwest have already been made, and very interesting results obtained. Eventually it is expected to incorporate the results of some of these investigations in a comprehensive report on the Mineral Waters of New Mexico.

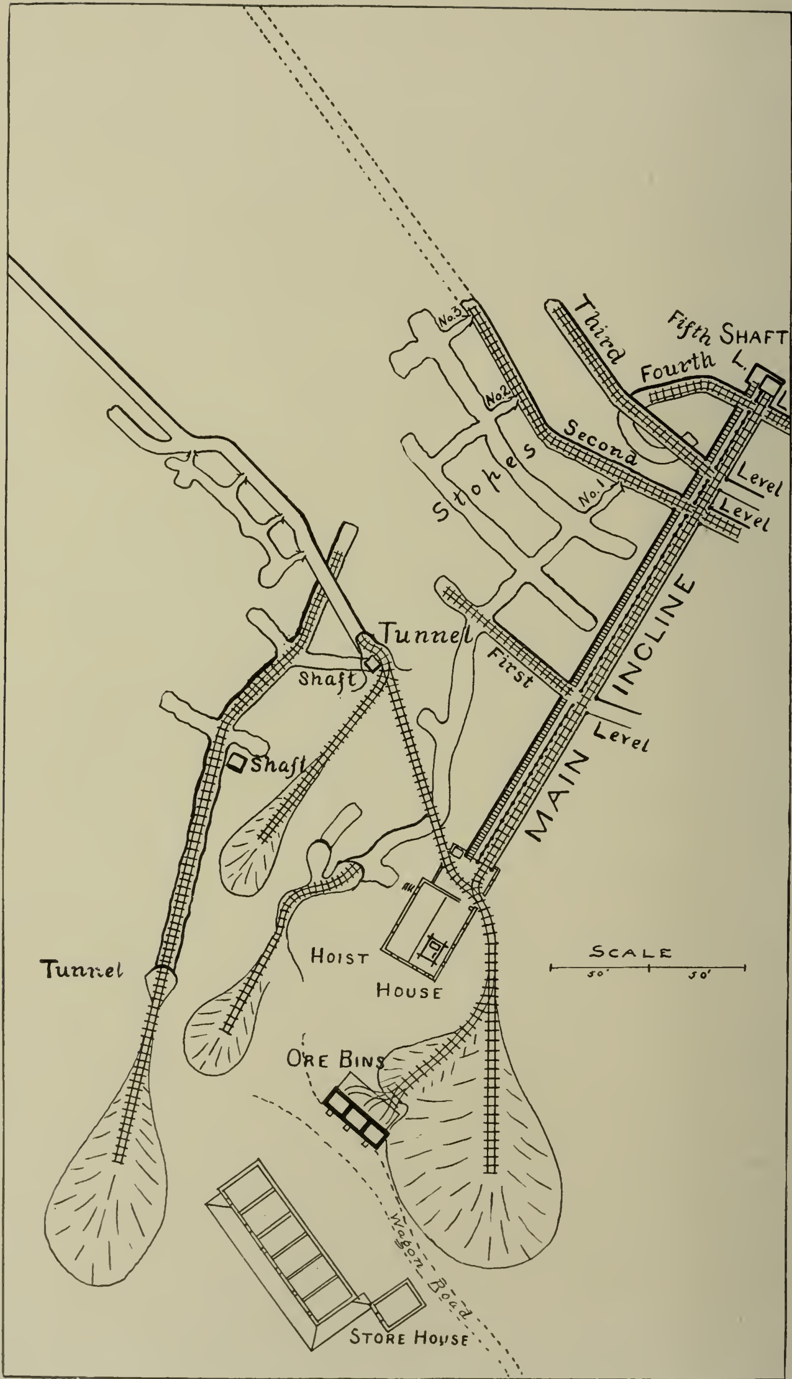
Fuel Analysis. Another branch of work which has been constantly receiving more attention has been an inquiry into the fuel values of the coals of the region. Complete analyses and heat tests, have been made of some of the principal deposits. With the work already done the results of new analyses are made of special value on account of the comparative figures that can be supplied..

Manufacturing Chemical Tests. In the mining regions of the Rocky Mountains occur, besides the metalliferous deposits, a large number of other substances which may be mined for their commercial values. The laboratories of the School are fully equipped to make determinative tests on the uses, methods of treatment and values of these minerals.

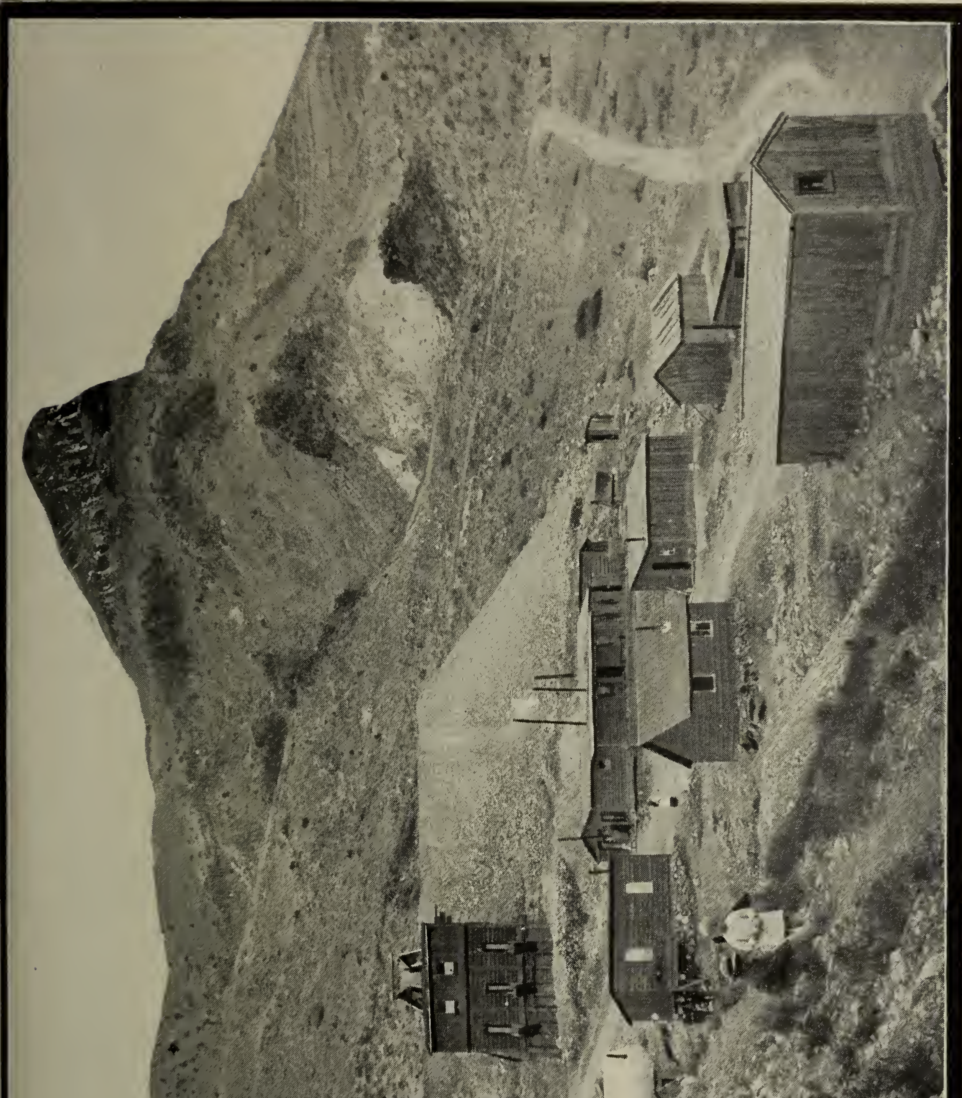
TORRANCE MINE FOR PRACTICAL MINING.

The School owns an important property, the Torrance Gold and Silver Mine, which it utilizes in instruction in practical mining.

The first attempt ever made to establish a practical mining laboratory in any educational institution by incorporating an actual mine to work in, is believed to be that begun in the summer of 1902 by the New Mexico School of Mines. At that time the possibilities were first considered for the use of the Rio Grande Smelting Works at Socorro, as a laboratory of practical metallurgy. As a companion experiment in mining education a laboratory for practical mining was thought of. Considerable time was spent in trying to find a suitable property upon which a model mine could be



PLAN OF THE TORRANCE MINE.



developed which would likely grow into a paying proposition and which at the same time would come within the limits of the School's purse. After thorough examination a small but promising property was finally acquired and plans made for developing it.

Soon afterwards a larger and more attractive mine was found to be on the market, and only a short distance from the college campus. Mainly through the generosity of Mr. W. H. Byerts, one of Socorro's prominent citizens, this property, with all its appointments, has come into absolute possession of the School. This property was long known as the Torrance Mine. Included in the deal is a bond and lease for a period of years on five adjoining properties.

The Torrance gold and silver mine has long been known as one of the most famous in the Southwest. It has a remarkable record. Already it has produced nearly $1,000,000 in values. This mine presents one of the finest examples of timbering in New Mexico. The main opening is through a double compartment incline. There are 5 levels. Important ore-bodies are opened up. Great variety in mining illustration is shown. There are fine stopes, and on the fifth level a shaft. The geological structures associated with ore deposits are seldom so well displayed. The problems presented are many. Variations innumerable are found in contiguous properties. The hoisting-house is substantially constructed, and the ore bins are capacious and well built..

Exceptional opportunities are thus offered students to carry on actual mining operations. Sinking of shafts, driving levels, constructing winzes, advancing development work, and stoping are included. Timbering in its various phases is undertaken. Complete surveys are made and maps drawn. The mine is thoroughly sampled and the samples assayed. The geological conditions are carefully studied both underground and on the surface. There is practice in reporting on mining properties and the evaluation of the ore-bodies. Plans and specifications are drawn up for all appurtenances connected with the operation of the mine under varied conditions and in relations with the milling. All other work of an engineering character receives attention.

GEOLOGICAL SURVEY OF NEW MEXICO.

For several years past there has been going on in connection with the School of Mines regularly organized work of a geological survey of New Mexico. The funds for carrying on the investiga-

tion were provided from various sources. During the past winter the Legislature, recognizing the great importance of this work, made special provision for conducting and extending the inquiries of the geological survey of New Mexico, and placed the expenditure of the appropriations under the direction of the Board of Trustees of the New Mexico School of Mines.

The organization of the Geological Survey was effected for the express purpose of (1) obtaining valuable data relating to the mineral resources of New Mexico, (2) disseminating this useful information among those interested in our greatest industry, and (3) training students in systematic investigations of mineral wealth according to the most modern methods.

The mineral treasures which are constantly coming to light in the neighboring states and other parts of the country give us every reason to believe that we have not as yet availed ourselves to the extent that we might of the natural riches which Nature has bestowed upon us, and suggests the expedience of a more thorough examination than has hitherto been made. There is now a general feeling pervading our commonwealth that great benefits would be derived from an economical investigation of the natural resources of our domain. Such an accurate geological and mineralogical survey by practical and scientific men leads to important discoveries. Not only are the advantages immediate, but the results of this series of researches have a lasting effect in aiding individual efforts for many years to come. At the present time more labor and money is wasted annually in the region in fruitless searches for mineral wealth than would support a liberal survey for years.

The geological character of a district indicates its features of relief, its agricultural capabilities, its mineral wealth; and a geological map serves every citizen as a faithful guide, giving him reliable information concerning his property and effectually protecting him against the wiles of nomadic speculators.

Already much valuable information has been accumulated by the various members of the geological corps. A preliminary geological map of New Mexico is rapidly approaching completion. A number of reports on various mineral deposits are in course of preparation. Several of these reports are soon to be presented. Both the economic and scientific aspects of the various questions are discussed.

Another purpose of the geological survey is to give the student practice in the administrative features of public scientific work, and the methods of correlated work.

Powers are also given the geological survey organization to co-operate with the United States Geological Survey. According to the present plans, it is expected that these organizations will be mutually benefited.

A number of reports are in various stages of preparation, and will be published in the order given below. Part I of the first volume is already in press; Part II is ready for the printer, and Part III is well advanced. These reports are:

Volume I. Geology of Underground Water Supplies..

Volume II. Geological Formations of New Mexico.

Volume III. Annual Report of the Director, and Accompanying Papers.

Volume IV. Coal Deposits of New Mexico.

Volume V. Areal Geology.

Volume VI. Conditions of Ore Depositions.

These reports will be followed by others on the various mineral deposits, the mining conditions, and kindred information of practical value.

In conducting the investigation of the geological survey exceptional opportunities are offered for working out geological problems of wide interest and publishing the results. The number of problems already formulated and awaiting solution is large.

EXAMINATIONS.

Matriculation examinations are held at the close of the year in June, for the next year, and at the beginning of the year in September.

Regular examinations, which all persons under instruction in the School are required to attend, are held at the end of each month, for the purpose of determining the progress of the students.

At the close of each semester are examinations covering the term's work in each subject. Candidates for degrees cover all their previous work in the final examinations.

Candidates for advanced standing may be examined, if deemed necessary, by the Faculty, in all studies, or any part of them, of their course preceding those of the class in which they wish to enter.

TUITION AND LABORATORY FEES.

Tuition Free.

The fee for tuition is fifty dollars a semester. To *bona fide* citizens of New Mexico, the tuition is ten dollars a semester. The tuition fee is payable in semi-annual installments at the beginning of each semester. All laboratory fees are payable at time of registration.

There is a matriculation fee of five dollars (paid only once). There is no extra fee for instruction in any department of study, or for lectures. For the use of the library and reading-rooms there is no fee.

Absence from School, or partial time devoted to the work of the School, does not admit of any deduction of fees.

Special examinations, granted by the Faculty to students at their request, are subject to a fee of five dollars.

Laboratory Fees.

The laboratory charges are chiefly nominal, mainly to cover the cost of materials used, and must be paid promptly on presentation of bills.

In chemistry, the laboratory fees are as follows: Inorganic Chemistry, $5.00; Qualitative Analysis, $10.00; Quantitative Analysis, $10.00.

In the metallurgical courses, the laboratory fees per semester are: For assaying, $10.00; for metallurgy, $10.00; ore-dressing, $10.00.

In the laboratories, other than the chemical and the metallurgical, the fees are from three to five dollars.

Graduation Fee.

The graduation fees, payable before delivery of diploma, are as follows:

Mining, Metallurgical, or Civil Engineer	$10.00
Bachelor of Science	5.00

EXPENSES.

In Socorro, the expenses for rooms, board and other necessaries are about the same, for similar accommodations, as in other parts of the United States. Before another year it is expected that

School dormitories will be ready. In this connection good substantial board may be furnished, it is thought, for $3.00 a week.

At the leading hotel of Socorro, the School has made arrangements whereby students on presenting a card from the Registrar may secure board by the month at $15.00.

Students may obtain good board at first-class boarding-houses and in private families at $18.00 to $23.00 a month. The cost of boarding may be considerably reduced below the minimum above given by the formation of students' clubs, and good results have been secured as low as $11.00 a month.

Three hundred dollars may be taken as a maximum for necessary expenses. Students may get along very well on $200.00 a year, if they are willing to economize.

STUDENT LOAN FUNDS.

Several loan funds have been established for the purpose of aiding worthy students who might be without such assistance unable to complete their courses in this institution. The conditions governing the distribution of the different loan funds are essentially the same in their main features, though differing somewhat in details.

Assistance thus offered is placed upon a strictly business basis, without thought of charity. Attached is no suggestion of a gift outright. Opportunity is presented the student to pay his own way, depending upon no one but himself. Moreover, it is assistance given at a time when the student most requires it.

The loans are made for three, four, or five years, and bear six per cent interest. The accrueing interest is added to the loan fund when the amount of the loan matures. Thus the interest, as it accumulates, goes towards enlarging the fund, which will from time to time also receive additions from other sources. With this gradual expansion of the loan fund its usefulness will be greatly broadened.

An important condition governing the loans is the previous record of the student as to his character and his work.

Byerts Loan Fund. This fund has been established by Mr. William H. Byerts, of Socorro, and important augmentations are promised soon.

The individual loans are of $50.00 and $100.00. In distributing the fund preference is given those students who have most nearly completed their courses. The loans are made upon the recom-

mendation of the Faculty by the Board of Managers, each note bearing six per cent interest and maturing in from three to four years.

Preliminary to receiving a loan the student shall file recommendations from at least two responsible persons in no way connected with the School. In all cases preference will be given those students nearest graduation. A very essential condition of the allotment is the previous good record of the student.

All accruing interest goes into the general loan fund for the benefit of other needy students.

Trustee's Loan Fund. As a further aid to needy students special loans are each year provided for. The amounts of these loans vary somewhat, but each is sufficient to cover the amount of all tuition and laboratory fees for the year. Only students in the last year of their course are eligible to the benefits of this special fund. Loans are allotted on the same conditions as other aid from the general loan fund.

DIRECTORY OF GRADUATES.

ARTHUR H. ABERNATHY. Cananea, Mexico.
Student, 1898–1901. From Pinos, Zacatecas, Mexico. Assayer, Cananea Smelting Works, Cananea, since 1901.

C. E. BARCLAY. Maria, Texas.
(A. B. University of Virginia.)
Student, 1896–7. From Bowling Green, Kentucky.

LOUIS AUGUST BERTRAND. Mapimi, Durango, Mexico.
Student, 1895–6. From Conway, Iowa. Student École Professionelle de l'East, Nancy, Lorraine, 1890–95; Instructor in Mathematics and French, New Mexico School of Mines, 1895–6; Chemist, El Paso Smelting Works, El Paso, Texas; Assayer and Surveyor, Consolidated Kansas City Smelting and Refining Co., Chihuahua, Mexico; Superintendent Carmen Mines, Coahuila, Mexico; Superintendent, Compania Mineros de Penales, Mapimi, Mexico, since 1901.

CHAUNCEY E. BUTLER. Dedrich, California.
Student 1893–6. From Kelley, New Mexico. Assayer Cibolo Creek Mill and Mining Co., San Francisco, California, 1896; Assayer and Furnace Superintendent, El Compania Minera Lustre, Magistral, Estado de Durango, Mexico, 1897–8; Chemist and Assayer, United Verde Copper Co., Jerome, Arizona, 1898–1903; Superintendent, Trinity County Gold Mining Co., and Jenny Lind and Maple Mining Co., Dedrich, California, since 1903.

EDWARD C. CHAMNEY. Minnehaha, Arizona.
Student, 1899–1900. From Shipley, Ontario, Canada. Assistant in General Science, New Mexico School of Mines, 1900–01; Assayer, Oro Mining Co., Minnehaha, Arizona, since 1901.

VIVIAN V. CLARK. Albuquerque, New Mexico.
Student, 1896–8. From Kelley, New Mexico. Assayer, Bland Milling Co., Bland, New Mexico, 1898–9; Superintendent, Navajo Gold Mining Co., Bland, New Mexico, 1900; Manager, Higueras Gold Mining Co., Sinaloa, Mexico, 1901. Mine Operator, Albuquerque, New Mexico, since 1902.

DAVID JOSHUE CLOYD. Aguas Calientes, Chihuahua, Mexico.
Student, 1899–1900. From Decatur, Illinois. Chemist in Wardman Assay Office, Aguas Calientes, Chihuahua, Mexico, since 1900.

NAISI AINSLEY CONNER. Douglas, Arizona.
Student, 1899–1900. From New York City. Superintendent, Copper Queen Mining Co., Douglas, Arizona, since 1900.

THEODORE STEWARD DELAY. Creston, Iowa.
(B. S. and M. E., Missouri School of Mines.)
Graduate Student, 1893–5. From Creston, Iowa. Assistant Professor of Chemistry, New Mexico School of Mines, 1894; Assayer, Tassel Mining and Milling Co., Alma, Colorado, 1895; Assistant Superintendent, I. X. L. Milling and Refining Co., Breckenridge, Colorado; Manager, Hoosier-Yukon Mining and Milling Co., Forty-Mile District, Alaska; Metallurgist, Creston-Colorado Mining Co., Creston, Iowa, since 1900.

LEON DOMINIAN. Denver, Colorado.
(B. A., Roberts College [Constantinople], 1898; C. I. M., Mining School, University of Liege, 1900.)
Graduate Student, 1903–4. From Constantinople, Turkey. Assistant, U. S. Geological Survey, 1903; Instructor in Mathematics, New Mexico School of Mines, 1903–4; Engineer to Victor Fuel and Iron Co., Denver, Colo., since 1904.

ROBERT CASIANO EATON. Comanjo, Jalisco, Mexico.
Student, 1893–4. From Socorro, New Mexico. Sampling Mill Foreman, Compania Metalurgico Mexicana, San Luis Potosi, Mexico, 1894–98: Superintendent, Muriedas Smelting Works, Xichu, State of Guanajuato, Mexico, 1898: Superintendent of Railroads, Compania Metalurgico Mexicana, 1899–1901; Superintendent, Verdolaga Mining Co., Concepcion del Oro, State of Zacatecas, Mexico, 1901–02; Superintendent, Negociacion Minera, Nuevo Cinco Senores de Comanja, State of Jalisco, Mexico, since 1902.

HARRY THORWALD GOODJOHN. Torreon, Mexico.
Student, 1902–3. From Pittsburg, Texas. Assayer, Cia. Metalurgico de Torreon, Torreo, State of Coahuila, Mexico, since 1903.

SAMUEL JAMES GORMLEY. Anaconda, Montana.
Student, 1895–6. From Mt. Vernon, Iowa. Assistant Professor of Engineering, New Mexico School of Mines, 1895–7; Assistant Assayer, Anaconda Copper Mining Co., Anaconda, Montana, 1897-1900; Chemist to same company, 1900–02: Superintendent of Sampling Works, Washoe Smelting Co., Anaconda, Montana, since 1902.

ANTON HOGWALL. Nogal, New Mexico.
Student, 1898–99. From White Oaks, New Mexico. Assayer, Buckeye Mining Co., Water Canyon, New Mexico, 1900; Assayer, South Homestake Mining Co., and Helen Rae Ming Co., White Oaks, New Mexico, 1981; Assayer, American Gold Mining Co., Nogal, New Mexico, since 1902.

CARL JOHN HOMME. Gulf Creek, N. S. W., Australia.
(A. B., St. Olaf College.)
Graduate student, 1899–1900. From Wittenburg, Wisconsin. Assayer and Chemist to Candelaria Mining Co., El Paso, Texas, 1900–01; Assistant Superintendent, Gulf Creek Mining Co., Gulf Creek, New South Wales, Australia, since 1902.

WILLIAM ELIAS HOMME. Gulf Creek, Australia.

(A. B., St. Olaf College.)

Graduate student, 1902–03. From Wittenburg, Wisconsin. Assayer Gulf Creek Mining Co., Gulf Creek, New South Wales, Australia, 1902.

JOHN AUGUST HUNTER. Aguas Calientes, Mexico.

(B. S., New Mexico School of Mines, 1903.)

Student, 1899–1903. From Socorro. Chemist, Consolidated Kansas City Smelting Co., El Paso, Texas, 1893–4; Chemist and Metallurgist, American Smelting and Refining Co., Aguas Calientes, Mexico, since 1904.

CHARLES THAYER LINCOLN. Iowa City, Iowa.

(S. B., Massachusetts Institute of Technology, 1901.)

Graduate Student, 1902–3. From Boston, Massachusetts, Chemist to American Bell Telephone Co., Boston, Mass., 1901–2; Assistant in Analytical Chemistry, New Mexico School of Mines, 1902–3; Acting Professor, same, 1903–4; Instructor in Chemistry, Iowa State University, Iowa City, since 1904.

FRANCIS CHURCH LINCOLN. Patagonia, Arizona.

(S. B., Massachusetts Institute of Technology.)

E. M., New Mexico School of Mines, 1902. Assayer to San Bernardo Mining and Milling Co., 1900: Chemist to Butterfly Terrible Gold Mining Co., 1900-01: Professor of Chemistry and Metallurgy, New Mexico School of Mines, 1901–02: Professor of Metallurgy, 1902-04; Assistant Superintendent, Ruby Gold and Copper Co., Ortiz, State of Sonora, Mexico, 1904; General Manager Arizona Gold and Copper Co., Patagonia, Arizona, since 1904.

HARRY C. MAGOON. Chicago, Illinois.

Student, 1899–1900. From Chicago, Illinois. Engineer with Illinois Steel Company, since 1900.

CONRAD M. MEYER. New York, N. Y.

(A. B., New York University. M. D., Bellevue Hospital.)

Graduate student, 1900–01. From New York City. Mining Engineer, 136 5th Avenue, New York City, since 1901.

TARVER MONTGOMERY. Santa Ana, California.

Student, 1899–1901. From Santa Ana, California. County Surveyor, Orange County, California, 1900-01. Assistant Engineer, Temescal Water Co., Carona, California, 1901; Transitman, San Pedro, Los Angeles, and Salt Lake Railroad Co., 1901–02; Assistant Engineer, Pacific Electric Railroad Co., Santa Ana, California, since 1902.

PATRICK J. O'CARROLL.*

(B. A., University of Dublin, Ireland.)

Graduate student, 1898–9. From Dublin, Ireland. Mine Operator, Gallup, New Mexico, 1899–1901.

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*Deceased.

ALVIN OFFEN.*

Student, 1895-6. From Butte, Montana. E. M., 1896; Assistant Superintendent, Philadelphia Mine, Butte, Montana, 1896-7.

JUAN PALISSO. Mexico.

Student, 1893-4. From Barcelona, Spain. Mining Engineer, Mexico.

FOUNT RAY. Italy, Texas.

Student, 1901-2. From Waxahachie, Texas. General Manager, Lena Mining and Concentrating Co., Lordsburg, New Mexico, 1902; Cashier, Citizens National Bank, Italy, Texas, since 1902.

ALBERT BRONSON RICHMOND. Patagonia, Arizona.

Student, 1900-01. From Las Priestas, Senora, Mexico. Superintendent, Ramona Mill Co., Gairlon, Senora, Mexico, 1901-2; Assayer, Patagonia Sampling Works, Patagonia, Arizona, 1902; Assayer and Metallurgist, Patagonia, Arizona, since 1902.

DELL FRANK RIDDELL. Chicago, Illinois.

(Ph.G., Chicago College of Pharmacy, 1896; B. S. Nebraska State University, 1901)

Graduate Student, 1903-5. From Sioux Falls, South Dakota. Professor of Chemistry, Sioux Falls College, 1901-3; Instructor in Chemistry, New Mexico School of Mines, 1903-4: Acting Professor of Assaying, same, 1904-5; M. E., same, 1905; Holder of Allis Chambers Scholarship, 1905-6.

WILLIAM CARLOS STEVENSON. Redlands, California.

Student, 1900-01. From Hillsboro, Ohio. General Manager, Mining Corporation, Albuquerque, New Mexico, since 1901.

JOHN STUPPE. Torreon, Coahuila, Mexico.

Student, 1893-4. From El Paso, Texas. Accounting Department, El Paso Smelting Works, El Paso, Texas, 1896-1902; Metallurgical Department, Compania Metalurgica de Torreon, Torreon, Coahuila, Mexico, since 1902.

LEO RICHARD AUGUST SUPPAN. St. Louis, Missouri.

Student, 1895-6. From St. Louis, Missouri. B. S. in Chemistry and Metallurgy, 1896; Instructor in Chemistry, New Mexico School of Mines, 1895-7; Graduate student, Johns Hopkins University, 1807-8; Professor of Chemistry, Marine-Sims College of Medicine, St. Louis, since 1898.

CHARLES L. SEARCY. Monterey, Mexico.

Student, 1893-4. From Peoria, Illinois. Mining Engineer, Monterey, Mexico.

CHARLES H. SHAMEL. Taylorville, Illinois.

(B. S., M. S., Illinois State University; L. L. B., Michigan University.)

Graduate student, 1901-02. From Taylorville, Illinois. Attorney at Law, Taylorville, Illinois, since 1902.

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*Deceased.

OLIVER RUSSELL SMITH. SOCORRO, New Mexico.
(B. S., Kansas College of Agriculture and Mechanic Arts, 1898.)
Graduate student, 1899–1901. From Manhattan, Kansas. B. S., in Civil Engineering, New Mexico School of Mines, 1901; Assistant in Mathematics and Draughting, New Mexico School of Mines, 1900-01: Instructor in Engineering and Drawing, New Mexico School of Mines, 1901–2; C. E., New Mexico School of Mines, 1903; Assistant Professor in Engineering and Drawing, New Mexico School of Mines, 1902; Assistant Surveyor, U. S. Land Office, 1902; City Engineer of Socorro, New Mexico, 1902: Deputy Mineral Surveyor, U. S. Land Office, 1903: Professor of Civil Engineering, New Mexico School of Mines, since 1902.

OTTO JOSEPH TUSCHKA. Monterey, Mexico.
Student, 1893–7. From Socorro, New Mexico. E. M., in Metallurgy, 1897; Assayer and Chemist, Graphic Smelting Works, Magdalena, New Mexico, 1897–8; Graduate student, New Mexico School of Mines, 1898-99; Assistant Sampling-Mill Foreman and Chemist, Guggenheim Smelting and Refining Co., Monterey and Aguas Calientes, Mexico, 1899–1900; Assayer, Seamon Assay Laboratory, El Paso, Texas, 1900; Chemist, Compania Minera Fundidora y Afinadora "Monterey," Monterey, Mexico, since 1900.

PATRICK ANDREW WICKHAM. Victor, Colorado.
Student, 1893–4. From Socorro, New Mexico. Assistant, Rio Grande Smelting Works, Socorro, New Mexico; Mechanical Engineer, Buckeye Mining Co., and Albemarle Mining Co., Bland, New Mexico, 1898–99; Mechanical Engineer, Mt. Beauty Mining Co., Cripple Creek, Colorado, 1899-1900; Engineer, Empire State Mining Co., Cripple Creek, Colorado, 1900-01; Engineer, Guggenheim Exploration Co., Minas Tecolotes, Santa Barbara, Mexico, 1901–02; Residence Engineer, Independence Consolidated Mining Co., Independence, Colorado, since 1902.

WAKELEY A. WILLIAMS. Grand Forks, British Columbia, Canada.
Student, 1893–4. From Council Bluffs, Iowa. Assistant Superintendent and Metallurgist, Granby Consolidated Mining, Smelting and Power Co., Grand Forks, since 1898.

ROLL OF STUDENTS.

(For Fiscal Year Ending November 30th, 1904.

Antonio Abeyta.................................Socorro.
George Oliver Arnold... ....Grinnell, Iowa.
Ph. B., Iowa College.
Adelino E. Baca...................... ....Socorro.
Alfredo Baca............. .. ..Lemitar, N. M.
David Baca............... ....Socorro.
Hermelindo Baca................................ "
Juan Jose Baca .... "
Louis C. de Baca...............................Endee, N. M.
Tomas J. Baca.. ....Socorro.
Vivian J. Baca.................................. "
Sidney Downer Bates ....Urbana, Ohio.
Herbert Dean Bemis............................Janesville, Wisc.
James Fielding Berry..........................Socorro.
P. T. Berry. .... "
Cony C. Rrown........................... .... "
Harry Lawrence Brown..........................Chicago, Ill.
Rafael Burns................... ....Socorro.
W. R. Calvert ....Richfield, Neb.
B. S., Nebraska State University.
George Franklin Card..........................St. Louis, Mo.
R. Harland Case.................................Los Cerrillos, N. M
Richard Stanhope Chamberlain...............Chicago, Ill.
Roberto R. Chavez........ ... .Socorro.
Anthony Collinson ....Claredon, Texas.
Samuel Cockerill...... ....North Fork, Va.
B. S., Valpariso University.
G. Coon.............. ....Socorro.
Andrew Jackson Cortesy. .... "
Luther Gross Crowley ....Council Grove, Kans.
Thomas Dennison Curry..........................Chicago, Ill.
Claude Harold Dailey ....Socorro.
Leon Dominian..................................Constantinople,Turkey.
B. A., Roberts College; C. I. M., Universty of Liége.
Joseph Eppele....................................Socorro.
C. Edward Fitch.................. .... "
M. J. Foreman........ ....Marion Center, Pa.
T. Fortune.... ....Socorro.
John Elmer Fullerton.......... ....Patterson, N. M.
Samuel Roland Ginsburg... ....New Haven, Conn.
C. Graham.................... ....Socorro.
Frank Graham... .... "

L. Graham .... Socorro.
S. Graham .... "
D. Gonzales .... "
Gregorio Gonzales .... Luis Lopez, N. M.
Victor Gonzales .... Lemitar, N. M.
H. G. Gordon .... Seattle, Wash.
I. H. Gordon .... " "
Hesekiah Hall .... Water Canyon, N. M.
Gay Montague Hamilton .... Cambridge, Ill.
B. S., Nebraska State University.
Henry Root Harris, Jr,, ... Socorro.
I. Harris .... "
Willis Hayes Hightower .... Frisco, N. M.
James Monroe Hill .... Socorro.
A. D. Hilton. .... "
B. Hilton .... "
Joseph Jacobson Hilton .... "
Pierre Van Acker Hines .... El Paso, Texas.
Rue Neil Hines .... Parral, Mexico.
Harry L. Hische .... Chicago, Ill.
Frederick Kilgore Howell .... Socorro.
Haynes Alfred Howell .... "
H. Howell .... "
Seth David Howell .... "
John Robert Howes, Jr .... Las Cruces, N. M.
William Edwin Hult .... Socorro.
John Archibald Hunt .... Providence, R. 1.
Clyde Cleveland Hurst .... Socorro.
J. M. Hurst .... "
Gerard Beach Imeson .... Gallup, N. M.
Aleck Jasper Jenkins .... Socorro.
B. I. Kealer .... "
P. H. Kealer .... "
B. Kutzner .... Stansbury, Mo.
B. E. Kutzner .... " "
E. D. Kutzner .... " "
Albert Henry Laufensweiler .... Fort Dodge, Iowa.
Dean Leeming .... Clifton, Aris.
M. Leeming .... " "
M. E. Liles .... Socorro.
Robert Lisles .... "
Patricio Lopez. .... "
Julian F. Luna .... Lemitar, N. M.
Ellis MacDougall .... Albuquerque, N. M
D. D. S., Baltimore Dental College.
Thomas Benjamin McCauley .... Deming.
James Edward McGee .... Kelley, N. M.
Morton K. McMillan .... Socorro.

Monroe Erasmus Merrill	Los Angeles, Calif.
Juan M. Miera	San Antonio, N. M.
Walter Lucas Miller	Santa Fe, N. M.
Charles Gainewell Montgomery	Pineville, Ky.
F. Montiel	Socorro.
Erle D. Morton	Prescott, Ariz.
William Frederick Murray	Raton, N. M.
Lieut. James Dynan Newton	Tularosa, N. M.
A. B. and A. M , Holy Cross College; Mec. E., Cornell University.	
Pedro Padilla	Escondida, N. M.
Allen Lesley Pearson	Linden, Tenn.
Francisco Pena	San Antonio, N. M.
Cardinio Pino	Socorro.
E. Richardson	San Antonio, N. M.
John Richardson	" " "
Thomas Richardson	" " "
Dell Frank Riddell	Lincoln, Neb.
B. S., Nebrasda State Univerity; Ph. G., Chicago College of Pharmacy.	
R. Sais	Los Lunas, N. M.
A. S. Sayler	Socorro.
C. H. Sayler	"
G. E. Sayler	"
Marcus Antonius Sayler	"
B. S., South Dakota Agricultural College; M. D., Minnesota State University.	
M. Sedivy	Cleveland, Ohio.
B. Smiley	Socorro.
James Avery Smith	"
Marvel Martin Smith	"
Edward Donald Swisher	Magdalena.
H. Terry	Socorro.
Benito Torres	"
Hilario Torres	"
L. Torres	"
Rojerio Torres	"
B. Vigil	"
A. Wattelet	"
Harvey Wells	Kelley, N. M.
Milton Benham Wescott	Chicago, Ill.
Harvey Chase Wood	Mt. Pulaski, Ill.
Estevan Zimmerly	Socorro.

NEW MEXICO SCHOOL OF MINES

1906-7

MAIN BUILDING.

ANNUAL REGISTER

OF THE

NEW MEXICO SCHOOL OF MINES

SOCORRO, N. M.

1905-6

WITH ANNOUNCEMENTS FOR 1906-7

SANTA FE, N. M.:
THE NEW MEXICAN PRINTING COMPANY
1906

CALENDAR.

1905–1906.

May 24 and 25—Spring examinations for admission.
September 11 and 12—Fall examinations for admission.
Monday, September 11—First semester begins.
Thursday, November 30—Thanksgiving recess.
Friday, December 22—Christmas vacation begins.
Wednesday, January 3—Work resumed.
January 17–19—Mid-year examinations.
Monday, January 22—Second semester begins.
Monday, May 21—Final examinations begin.
Friday, May 25—Commencement.

1906–1907.

May 24 and 25—Spring examinations for admission.
September 10 and 11—Fall examinations for admission.
Monday, September 10—First semester begins.
Thursday, November 29—Thanksgiving recess.
Friday, December 21—Christmas vacation begins.
Monday, January 7—Work resumed.
January 21 and 22—Mid-year examinations.
Wednesday, January 23—Second semester begins.
Wednesday, May 22—Final examinations begin.
Friday, May 24—Commencement.

FACULTY.

ROBERT PEELLE NOBLE, A. M., *President of the Faculty, 1906—; Professor of Chemistry.*

Ph. B., De Pauw University, 1891: Assistant in Chemistry, DePauw University, 1889; Graduate student, Johns Hopkins University, 1892; A. M., DePauw University, 1894; Principal Crawfordsville High School, 1894-1897; Graduate student, University of Chicago, 1897-1898, 1900-1901 and 1903-1904; Professor of Chemistry, Vincennes University, 1898-1900; Assistant Professor of Chemistry, Armour Institute of Technology, 1901-1904; Professor of Chemistry, New Mexico School of Mines, 1904—; President of New Mexico School of Mines, 1906—.

CHARLES ROLLIN KEYES, A. M., Ph. D., *President of the Faculty, 1902-1906; Professor of Mining Geology.*

B. S., Iowa State University, 1887; A. M., Iowa State University, 1890; Ph. D., Johns Hopkins University, 1892; University Scholar, J. H. U., 1889; Fellow in J. H. U., 1891; Fellow by Courtesy, J. H. U., 1892; Assistant U. S. Geological Survey, 1889-1892; Chief Geologist and Paleontologist, Missouri Geological Survey, 1890-1892; Assistant State Geologist of Iowa, 1892-1894; Director of Bureau of Geology and Mines of Missouri, 1894-1897; Travel in Europe, 1897-1898; Consulting Mining Geologist, 1890-1905; Consulting Mining Engineer, Santa Fe Central Railroad Co., 1902-1903; Consulting Mining Geologist, New Mexico Fuel and Iron Co., 1902-1905.

EMMET ADDIS DRAKE, A. M., *Professor of Languages.*

A. B., Wisconsin University, 1882; A.M., Wisconsin University, 1887; Assistant Engineer, Northern Pacific Railroad Co., 1882-1883; Instructor in Rhetoric and Oratory, Wisconsin University, 1883-1884; Instructor in Missouri School of Mines, 1884-1891; General Manager, Columbia Mining Co., 1891-1897; Professor of Languages, New Mexico School of Mines, 1897—; Editor Socorro Chieftain, 1900—.

OLIVER RUSSELL SMITH, B. S., C. E., *Professor of Civil Engineering.*

B. S., Kansas State Agricultural College, 1898; C. E., New Mexico School of Mines, 1902; Graduate student, Kansas State Agricultural College, 1898-1899; Graduate student, Kansas State University 1899-1901; Instructor in Mathematics and Draughting, New Mexico School of Mines, 1900-1902; Assistant Surveyor, United States General Land Office, 1902; Assistant Professor of Engineering, Surveying and Dranghting, N. M. S. M., 1902; City Engineer of Socorro, 1902—; United States Deputy Mineral Surveyor, 1903—.

ROBERT BRUCE BRINSMADE, E. M., *Professor of Mining and Metallurgy.*

B. S., Washington University, 1894; E. M., Lehigh University, 1895; Mine Examiner, Parrot Copper Co., Butte, Montana, 1897; Constructing Engineer, Anaconda Copper Mines, Butte, Montana, 1898; Mining Engineer, War Eagle Gold Mine, Rossland, B. C., 1899; Constructing Engineer, Senator Clark's Copper Smelter, Butte, Montana, 1900; Metallurgist, Columbia Lead Co., St. Louis. Mo., 1901; Superintendent and Mine Examiner, Cia de Fundicion, Cordoba, Argentina, S. A., 1902; Constructing Engineer, Sennet-Solvay Coke Co., Syracuse, N. Y., 1903 & 1904; Superintendent, Rossie Iron Mines, St. Lawrence County, N. Y., 1905; Professor of Mining and Metallurgy, New Mexico School of Mines, 1905-1906.

RALPH WALDO TWINING, A. B., *Principal of the Academy.*

A. B., Ottawa University, Ottawa, Kansas, 1901; Principal of Homestead Public School, 1902; Graduate student and Instructor of English, Ottawa University, 1903; Principal of Santa Fe High School, 1904; Principal of the Academy of the New Mexico School of Mines, 1905—.

MISS ANNE W. FITCH..... ....*Registrar.*

New Mexico School of Mines.

HISTORICAL SKETCH.

The New Mexico School of Mines is an institution founded by act of the legislature of 1889. Under a subsequent act of Legislature, approved February 28, 1891, a board of trustees was appointed and an organization effected. Immediate steps were taken towards the erection of necessary buildings. Plans and specifications were drawn by Messrs. Thayer and Robinson, architects of New York City, representing the most modern requirements developed by the experience of the leading technological institutions of the country.

Early in 1892, a Circular of Information, regarding the New Mexico School of Mines, at Socorro, New Mexico, was issued by the Board of Trustees. In this circular the aims of the school were fully set forth. The following year a president was chosen and students in chemistry were admitted; but it was not until the autum of 1895 that the Mining School was really opened.

The Legislative act creating it provides that the School of Mines shall be supported by an annual tax of one-fifth of a cent on all taxable property. This levy was increased by the Legislature in 1899 to twenty-seven and one-half one-hundredths of a mill. The 34th General Assembly, in 1901, recognized the growing importance of the School by further increasing the tax levy to thirty-three one-hundredths of a mill. In 1903, the 35th General Assembly raised the millage to forty-five one-hundredths of a mill. This, with greatly increased assessed valuation of property doubled the income of the School over that of the previous year.

In 1891, a special appropriation of $4,000 was made for the partial equipment of the Chemical and Metallurgical Laboratories; and in 1893 another special appropriation of $31,420 was made, to enable the School of Mines to be organized in accordance with the policy outlined by the act creating the institution.

By Act of Congress, approved June 21, 1893, the New Mexico School of Mines received for its share of certain grants of land, fifty thousand acres for its support and maintenance.

This liberal and valuable grant of land in a part of the country which is rapidly being opened up by eastern capital will soon place the institution on a strong financial basis. In this respect the income derived will eventually put the School of Mines of New Mexico on the same footing as other leading schools of technology in the country.

Already valuable aid is beginning to flow towards the School through this newly opened channel. Three years ago a fund of over $13,000 was realized from certain portions of these lands. A year later a somewhat smaller sum was made available. During the past year the income from this source was nearly $10,000. The 34th Legislative Assembly authorized the bonding of any portion of this grant of lands, in order more thoroughly to equip the School with buildings and apparatus for the proper execution of its growing needs.

STATUTES RELATING TO THE SCHOOL.

Some of the sections of the Act creating the School of Mines are as follows:

The object of the School of Mines created, established and located by this Act is to furnish facilities for the education of such persons as may desire to receive instruction in Chemistry, Metallurgy, Mineralogy, Geology, Mining, Milling, Engineering, Mathematics, Mechanics, Drawing, the fundamental laws of the United States and the rights and duties of citizenship, and such other courses of study, not including Agriculture, as may be prescribed by the Board of Trustees.

The management and control of said School of Mines, the care and preservation of all property of which it shall become possessed, the erection and construction of all buildings necessary for its use, and the disbursement and expenditure of all moneys appropriated by this Act, or which shall otherwise come into its possession shall be vested in a board of five trustees, who shall be qualified voters and owners of real estate; and trustees shall possess the same qualifications, shall be appointed in the same way, and their terms of office shall be the same, vacancies shall be filled in like manner, as

is provided in Sections 9 and 10 of this act. Said trustees and their successors in office shall constitute a body corporate under the name and style of "The Trustees of the New Mexico School of Mines," with right as such of suing and being sued, of contracting and being contracted with, of making and using a common seal and altering the same at pleasure, and of causing all things to be done necessary to carry out the provisions of this Act. A majority of the board shall constitute a quorum for the transaction of business, but a less number may adjourn from time to time.

The immediate government of their several departments shall be instrusted to the several faculties.

The board of trustees shall have power to confer such degrees and grant such diplomas as are usually conferred and granted by other similar schools.

The trustees shall have power to remove any officer, tutor or instructor or employee connected with said school when in their judgment the best interests of said school require it.

The board of trustees shall require such compensation for all assays, analyses, mill-tests, or other services performed by said institution as they may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines for said institution, and an accurate account thereof shall be kept in a book provided for that purpose.

LOCATION.

The New Mexico School of Mines is located at Socorro, the capital of Socorro County, in the central part of the commonwealth. The location is on the main line of the Atchison, Topeka and Santa Fe railroad, 75 miles south of Albuquerque, and 180 miles north of El Paso. The Magdalena branch of the Santa Fe railway starts from this place.

Socorro is pleasantly situated in the broad fertile valley of the Rio Grande, at the foot of the Socorro range of mountains. The altitude of the town is about 4,600 feet above the sea. The location is pre-eminently pleasant and healthful. The city has long been attractive to health-seekers who wish a mild, dry and invigorating climate, and many persons every year have sought its hospitalities. It is one of the ideal residence places of the region. The scenery is quite diversi-

fied by plains, broad valley slopes, mesas, varied hill country and lofty mountains. In the city are two hotels, a number of good boarding houses, two large public school buildings, and a court house, recently completed at a cost of $50,000. The churches represented are the Presbyterian, Roman Catholic, Episcopal and Methodist.

Socorro has a system of public water supply. The water is very soft and pure, and is furnished by hot springs which, four miles away, issue from the Socorro mountain. Two newspapers are published and a modern artificial ice plant and a large roller-process flouring-mill are in operation.

The ground immediately adjacent to the School of Mines include irrigable land, plateaus and mountain formations, all affording an excellent field for practice in surveying, the laying out of railroads and irrigating canals, topography, mine engineering and geology, so that students can be prepared at the very doors of the School in those branches which usually require tedious excursions from most other schools.

The New Mexico School of Mines enjoys the natural advantage of being located in the midst of a region peculiarly rich in minerals of nearly all kinds, and is within easy reach of the most varied geological conditions, all of which are within a radius of a score of miles of Socorro. Almost the entire geological column from the precious metal-bearing formations of the Archean to the coal beds of the Tertiary is here exposed. The industrial processes connected with mining and metallurgy may be seen admirably illustrated at Magdalena, Kelly, Rosedale, San Pedro, Hillsboro, Cook's Peak, Silver City, Pinos Altos, Los Cerrillos, Gallup, Carthage, and elsewhere within easy reach of the School. These illustrate the most modern methods of mining, milling, ore-dressing, concentrating, smelting, lixiviation, chlorination, etc., as well as the native Mexican methods, which are worthy of a careful study, since the like cannot be seen elsewhere in the United States.

A large number of mines of all kinds, smelters, irrigating systems and other engineering works are accessible to the School. Within a few hours' ride by rail, are many important mining camps. The longer excursions bring the student to some of the most famous mines in southwestern United

States. Some of the longest worked lodes in America are in this region. For more than 350 years they have yielded their wealth to the European and, centuries before his advent, gave up even greater treasures to the native races.

If we look into the history of modern mining schools, we find that each becomes most celebrated along the line for which its locality is best known on account of its natural surroundings. Few institutions of learning are more dependent for success upon what may be called the accident of geographical location than the mining school. It may be truthfully said that no mining school is more fortunately situated so far as natural environment is concerned than that of New Mexico.

PURPOSE.

The ideal to which the New Mexico School of Mines tenaciously holds is the practical directing of young men to take active part in the development of the mineral wealth of our country and the world.

The New Mexico School of Mines is a territorial institution. It was established primarily to promote mining and mining interests in southwestern United States. However, it has a much wider scope, providing, as it does, adequate facilities for thorough training in the methods of modern mining, and meeting the demands for a mining education, not only from young men who are residents of New Mexico, but from students from other parts of the country desiring to avail themselves of the peculiar advantages of this region.

During the entire period of his training the fact is impressed upon the student that intelligent mining is strictly a business operation, that mining is to-day as capable of being put on a secure business foundation as any manufacturing enterprise; that from start to finish it is a proposition akin to all the great business workings, such as enable the railroad train or the ocean liner to run with certainty and dispatch; that while "lucky finds" will continue to be made, mining as a business is no longer a vast lottery, ever developing to their fullest extent the gambling propensities of mankind.

During the past quarter of a century the development of

the mineral wealth of the Nation has been phenomenal. Of late the call for adequately prepared young men to direct mining enterprises in all their various ramifications has been unprecedented.

ADVANTAGES.

Several features contribute to the success of this institution as a school of mines.

The unique natural surroundings of the School, already described, create an invigorating mining atmosphere which is entirely wanting in situations away from the mines and mountains.

In the training offered by the School there is noteworthy concentration of effort. There are many advantages in the direction of effort along few lines. In contrast with the many diversions that necessarily exist in most technical institutions of learning, where all practical branches are equally represented, singleness of purpose is a leading feature in the New Mexico School of Mines. The conservation of energy growing out of the special methods of instruction happily adapts the student so that he gets the most out of his efforts.

The student is required as an integral part of his course, to visit and critically inspect, under the direct supervision of his instructors, various plants and works, and to make intelligent reports. Being obliged from the start to make the most of the exceptional opportunities presented, he quickly falls into the spirit of his present and future work, and at once necessarily acquires for his chosen profession a sympathy that is seldom attained except after school days are over and after long and strenuous effort.

Being within short distances of mines and smelters, the student has the opportunity of finding regular employment during his vacations and of acquiring desirable experience in practical work.

The field for original scientific research in New Mexico is unrivalled by any other mining region and the opportunities here offered are not neglected in the plan and scope of instruction. New Mexico, so far as concerns the mountainous portion, which comprises nearly two-thirds of its area and is nearly all mineral-bearing, is perhaps less known geologically

than any other section of the United States. A little study of the plateau region of the northwestern portion of the territory has been made by the United States Geological Survey, but only in a general way. No attempt has ever been made, under government auspices, to investigate closely the geological structure of New Mexico mountains such as has been carries out in the other Rocky Mountain states, or to study the conditions of New Mexican mineral deposits, as has been done in Colorado by Emmons, in Nevada by Curtis, in California by Becker, and in other states by other distinguished investigators.

It is proposed that much of the advanced professional work of the school shall be of an original nature, to the end that the graduates may be skilled, theoretically and practically, in the very problems which they, as professional men, will be called upon to solve. In connection with this work, it is hoped to enlist every chemist, geologist, mining engineer, metallurgist and other scientific investigator capable of observing and recording professional experience in the region. This work will be carried on by the advanced students, under the direction of the professors, and wil involve the collection of notes, sketches, maps and specimens, and the results of directed observation in all matters relating to the sciences and arts embraced in the courses of study. The results of these observations, together with the illustrations and analyses, will be printed from time to time by the School. While this plan of instruction will furnish material for practical and original research on the part of the advanced students, it is believed that it will also be of great practical utility to the industries of the Southwest, and that, in an important sense, the School will have for its students not only those who may study within its walls, but also the greater part of the educated mining population of the region.

The subjects for such researches in geology and mining, and in the reduction of the ores of lead, silver, gold and copper are so numerous that is impossible to do more here than to mention the fact that the conditions of climate, drainage, water-supply and geological structure in New Mexico differ greatly from the conditions existing in other parts of the Rocky Mountains, giving rise to new problems in practice.

These problems are not by any means all that deserve attention. The investigations of the ores of iron, manganese, aluminum, cobalt, nickel, tin and quick-silver, together with the beds of coal, salt, alums, building stones, mineral-paints, cement-rocks, marls, etc., will be directly in the line of the advanced laboratory work of the School, and every student who undertakes such work will be encouraged in every way possible to accomplish the best results.

ORGANIZATION.

The general management of the New Mexico School of Mines is vested in a Board of Trustees consisting of five members appointed by the Governor of the Territory with the concurrence of the Council for a term of four years. The Board of Trustees elect a President from its members and also a Secretary and Treasurer. The appointment of a president of the faculty of the School is also made by them.

By reason of a recent legislative act the maintenance of a preparatory department is required of the higher educational institutions of the Territory. The New Mexico School of Mines thorefore is composed of the Academy and the College.

THE ACADEMY.

While it is impossible, without a considerable increase in the present faculty. to teach all the usual academy subjects, the instruction offered in the Academy more than covers the subjects which are essential to admission into the College, so that a student who desires to enter the College but whose preparation has been inadequate, is enabled to make up his deficiencies. In the Academy are taught English, Geography, United States History, Arithmetic, Algebra, Geometry, Biology and Latin.

THE COLLEGE,

The Requirements for Admission.

Candidates for admission to the College must show a satisfactory degree of proficiency in the following subjects, either by examination or by the presentation of statements from schools of recognized standing:

English.

Exercises are given consisting of writing from dictation,

the correction of phrases and the writing of a short essay, attention being paid to the writing, spelling, punctuation and clearness of expression.

Geography.

This embraces the usual divisions of general, physical, political and commercial geography.

History.

United States History to the extent usually taught in high schools.

Algebra.

Through quadratic equations and the fundamental work which this presumes.

Geometry.

Both plane and solid geometry, Wentworth's text or its equivalent.

Advanced Standing.

Credits for courses required in the College will be given to students either upon their passing an examination in such courses or upon their presentation of a certificate from an approved educational institution showing that they have satisfactorily completed such courses; provided that not more than the first two years of the college courses be thus credited. Certificates of credit for such courses should be presented, or examinations for credits should be arranged for, at the time of matriculation.

Students who have matriculated with the intention of graduating but whose preparatory work is incomplete, will be required to complete such work and become regular as soon as possible.

It cannot be urged too strongly that students expecting to matriculate with this institution come prepared to take up the work without conditions. Every candidate for admission to the School may rest assured that after entrance his time will be fully occupied.

Special Courses.

Students not intending to graduate, but desiring to take special courses, may be registered for such courses provided they give evidence of proficiency in the prerequisite subjects

and provided their acceptance into such courses does not necessitate an unsatisfactory schedule of classes.

Curricula.

The curricula of the College are planned especially to meet the needs of students intendings to engage in mining or metallurgical industries, in mine-experting or in surveying mines and mining lands. Accordingly, curricula are offered in the following:

MINING ENGINEERING.

METALLURGICAL ENGINEERING.

MINING GEOLOGY.

CIVIL ENGINEERING.

Each curriculum covers four years. Upon the satisfactory completion of the courses of the first three years, the bachelor's degree is given; and at the end of the year following (the fourth year) the engineer's degree is conferred.

The selection and articulation of the various courses are believed to be such as to properly adjust them to the main theme. It is believed that very nearly the due proportions of time are given to the theoretical aspects of the subjects, laboratory-demonstrations, field-practice and actual work.

The several departments of the School are drawn upon, each according to its relative importance in mining operations. The courses offered by each department are quite complete as a connected and dependent sequence on a given subject. But in each curriculum only certain courses are essential, as bearing directly upon the profession in view. In mining engineering, for example, the laws and principles laid down by mathematics, mechanics and physics form the foundation upon which the superstructure of the professional training is built. The natural sciences of mineralogy, geology, chemistry, metallurgy and biology furnish indispensable data. Mechanical and civil engineering subjects contribute largely to a complete mining course.

In the adjustment of the courses of the several curricula, it was assumed that one hour's work in the class-room requires two hours of preparation, and therefore that one hour's work in the class-room is equivalent to three hours'

work in the field or in the laboratory. In the following outlined statement of curricula, the number of hours per week required in the class-room (C. R.) and in the field or in the laboratory (F. & L.) are given separately. The number of hours required in the field or in the laboratory represents *average* time however, inasmuch as it is frequently advantageous, especially for field-work, to concentrate into one week an amount of work equal to that which would require two or more weeks if performed in separate installments.

MINING ENGINEERING.

MINING ENGINEERING.

FIRST YEAR.

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	First Semester. F. & L.	Second Semester. C. R.	Second Semester. F. & L.
I. 5.	College Algebra	5		5	
I. 6.	Trigonometry	5			
I. 7.	Analytical Geometry			5	
VI. 1.	General Surveying			3	4
VI. 2.	Plotting Surveying				2
I. 3.	Descriptive Geometry	3			
I. 4.	Mechanical Drawing and Lettering		4		4
VI. 3.	Free-hand Drawing		3		
III. 1, 2.	General Chemistry	5	9	3	
III. 3.	Qualitative Chemical Analysis			1	6
III. 4.	Blowpipe Analysis				3
VIII. 1.	Spanish, (or German or French)	2½		2½	
IV. 3.	Hygiene and First-aid	1			

MINING ENGINEERING.

SECOND YEAR.

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	First Semester. F. & L.	Second Semester. C. R.	Second Semester. F. & L.
II. 8.	Calculus	4		4	
VI. 4.	Mine Surveying	2	4		
VI. 6.	Topographical Drawing				2
II. 1, 2.	General Physics	5	3	5	
II. 6.	Power and Power Transmission			3	
II. 7.	Engine Laboratory		1		
VI. 8.	Masonry Construction			3	
VII. 1, 2.	Mineralogy	3	3	3	3
III. 5.	Quantitative Chemical Analysis	1	9		
IX. 1.	Fire Assaying			1	8
III. 6. 7.	Fuel and Water Analysis	1			6
V. 2.	Spanish (or German or French)	2½		2½	

MINING ENGINEERING.

THIRD YEAR.

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	F. & L.	Second Semester C. R.	F. & L.
II. 3, 4.	Analytical Mechanics..............	5		4	
II. 8.	Hydraulics..........................	4			
VI. 11.	Stresses			3	
II. 5.	Machine Design.....................			2	4
VIII. 5.	Ore Dressing........................			3	
VIII. 1, 2.	Mining Methods.....................	5		3	
VIII. 3.	Examination of Mining Methods...				5
VII. 3.	Principles of Geology..............	3	3	3	3
VII. 4, 5.	Economic Geology..................	2		2	
III. 8.	Wet Assaying.......................	1	6		
IX. 3.	General Metallurgy.................	3			
II. 7.	Engine Laboratory.................		1		

MINING ENGINEERING.

FOURTH YEAR.

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	F. & L.	Second Semester. C. R.	F. & L.
VI. 12.	Graphical Statics...................			3	5
VI. 13.	Structural Details, A..............	2	6	2	6
VIII. 7.	Mine-Plant Design..................		6		6
VIII. 6.	Mine Plant..........................	3		3	
VIII. 4.	Mine Examination..................		10		
	Ore-Dressing Plant Design..........		4		
VII. 14.	Ore Deposits........................	4	3		
IX. 7.	Metallurgy of Iron..................	2			
VIII. 9.	Mining Law..........................	½			
VIII. 8.	Mine Administration and Accounts	2			
VI. 16.	Contracts and Specifications.......	2			
	Thesis................................				35

METALLURGICAL ENGINEERING.

METALLURGICAL ENGINEERING.

SECOND YEAR.*

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	F. & L.	Second Semester. C. R.	F. & L.
I. 8.	Calculus	4		4	
II. 1, 2.	General Physics	5	3	5	
II. 6.	Power or Power Transmission			3	
II. 7.	Engine Laboratory		1		
VII. 1, 2.	Mineralogy	3	3	3	3
IX. 3.	General Metallurgy	3			
IX. 4.	Metallurgy of Lead			2	
III. 5.	Quantitative Chemical Analysis	1	9		
IX 1.	Fire Assaying			1	8
III. 6, 7.	Fuel and Water Analysis	1			6
V. 2.	Spanish (or German or French)	2½		2½	

METALLURGICAL ENGINEERING.

THIRD YEAR.

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	F. & L.	Second Semester. C. R.	F. & L.
II. 3, 4.	Analytical Mechanics	5		4	
II. 8.	Hydraulics	4			
VI. 11.	Stressess			3	
II. 5.	Machine Design			2	4
VIII. 5.	Ore-Dressing			3	
VIII. 1. 2.	Mining Methods	5		3	
VII. 3.	Principles of Geology	3	3	3	3
VII. 4, 5.	Economic Geology	2		2	
III. 8.	Wet Assaying	1	6		
III. 9	Iron and Steel Analysis		3		3
IX. 5 (or 7)	Metallurgy of Copper (or Iron)	2			
IX. 6.	Metallurgy of Gold and Silver			2	

* The courses of the first year are the same as in the first year of Mining Engineering.

METALLURGICAL ENGINEERING.

FOURTH YEAR.

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R	F. & L.	Second Semester. C. R.	F. & L.
VI. 12.	Graphical Statics			3	5
VI. 13.	Structural Details, A	2	6	2	6
VIII. 6.	Mine-Plant	3		3	
	Ore-Dressing Plant Design		4		
VII. 14.	Ore-Deposits	4	3		
IX. 5 or 7.	Metallurgy of Copper or of Iron	2			
IX. 8.	Metallurgical Inspection		10		
IX. 9.	Metallurgical Design		6		6
VIII. 8.	Mine Administration and Accounts	2			
VI. 16.	Contracts and Specifications	2			
	Thesis				35

MINING GEOLOGY.

MINING GEOLOGY.

SECOND YEAR. *

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	F.&L.	Second Semester. C. R.	F.&L.
VI. 4.	Mine Surveying	2	4		
II. 1, 2.	General Physics	5	3	5	
VII. 1, 2.	Mineralogy	3	3	3	3
VII. 3.	Principles of Geology	3	3	3	3
VII. 4, 5.	Economic Geology	2		2	
III. 5.	Quantitative Chemical Analysis	1	9		
IX. 1.	Fire Assaying			1	8
III. 10.	Rock Analysis				6
IV. 1.	General Biology			1	3
V. 2.	Spanish (or German or French)	2½		2½	

MINING GEOLOGY.

THIRD YEAR.

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	F.&L.	Second Semester. C. R.	F.&L.
VII. 6.	Dynamical Geology	3	3		
VII. 7. / VII. 8.	Structural Geology / Stratigraphical Geology			6	3
VII. 9.	Practical Geology	1			
VII. 10.	Topographical Mapping		6		
VII. 11.	Geological Surveying, A			1	6
IV. 2.	Paleontology	2	3	2	3
VII. 13.	Petrography	3	6	3	6
VII. 14.	Ore-Deposits	4	3		
VIII. 1, 2.	Mining Methods	5		3	
VII. 15.	Special Problems				12

* The courses of the first year are the same as in the first year of Mining Engineering.

MINING GEOLOGY.

FOURTH YEAR.

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	F. & L.	Second Semester. C. R.	F. & L.
VII. 12.	Geological Surveying, B............				
VII. 16.	Geological Correlation..........,...				
VII. 17, 18.	Ore Deposition....................				
VII. 19.	Geological Philosophy.............				
VII. 20.	History of Geology.................				
VII. 21.	Research..........................				
VII. 22.	Thesis................				

The time for these courses will be apportioned later.

CIVIL ENGINEERING.

CIVIL ENGINEERING.

SECOND YEAR. *

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	First Semester. F.&L.	Second Semestea. C. R.	Second Semestea. F.&L.
I. 8.	Calculus......	4		4	
VI. 4.	Mine Surveying......	2	4		
VI. 6.	Topographical Drawing......				2
II. 1, 2.	General Physics......	5	3	5	
VI. 8.	Masonry Construction......			3	
VII. 1, 2.	Mineralogy......	3	3	3	3
III. 5.	Quantitative Chemical Analysis...	1	9		
I. 9.	Mathematical Astronomy......	3			
VI. 5.	Railway Surveying......			3	6
VI. 7.	Roads and Pavements......			2	
V. 2.	Spanish (or German or French)...	2½		2½	

CIVIL ENGINEERING.

THIRD YEAR.

Course Nnmbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	First Semester. F.&L.	Second Semester. C. R.	Second Semester. F.&L.
II. 3, 4.	Analytical Mechanics......	5		4	
II. 8.	Hydraulics......	4			
VI. 11.	Stresses......			3	
VII. 3.	Principles of Geology......	3	3	3	3
I. 10.	Method of Least Squares......	2			
VI. 12.	Graphical Statics......			3	5
VI. 10.	Railway Location......			3	
VI. 9.	Sanitary Engineering......	2			
VI. 17.	Water Supply......			3	
III. 6, 7.	Fuel and Water Analysis......	1	6		
IX. 7.	Metallurgy of Iron......	2			
III. 9.	Iron and Steel Analysis......		3		3
	Spanish (or German or French)....	2½		2½	

* The courses of the first year are the same as in the first year of Mining Engineering.

CIVIL ENGINEERING.
(Structural Engineering.)
FOURTH YEAR.

Course Nnmbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	First Semester. F.&L.	Second Semester. C. R.	Second Semester. F.&L.
VI. 13.	Structural Details, A	2	6	2	6
VI. 18.	Sewerage and Drainage	3			
II. 6.	Power and Power Transmission			3	
VI. 15.	Concrete Structures	5			
VI. 14.	Structural Details, B	2	9	2	9
I. 11.	Geodesy			5	3
VI. 16.	Contracts and Specifications	2			
	Collateral Reading		18		6
	Thesis				15

CIVIL ENGINEERING.
(Hydraulic and Irrigation Engineering.)
FOURTH YEAR.

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	First Semester. F.&L.	Second Semester. C. R.	Second Semester. F.&L.
VI. 13.	Structural Details, A	2	6	2	6
VI. 18.	Sewerage and Drainage	3			
II. 6.	Power and Power Transmission			3	
VI. 15.	Concrete Structures	5			
VI. 20.	Hydraulic and Masonry Design	1	6	1	6
VI. 19.	Irrigation Engineering	3			
VI. 21.	Irrigation Structures			2	
I. 11.	Geodesy			5	3
VI. 16.	Contracts and Specifications	2			
	Collateral Reading		15		6
	Thesis				15

CIVIL ENGINEERING.

(Sanitary Engineering.)

FOURTH YEAR.

Course Numbers.	COURSES.	HOURS PER WEEK.			
		First Semester.		Second Semester.	
		C. R.	F. & L.	C. R.	F. & L.
VI. 13.	Structural Details, A	2	6	2	6
VI. 18.	Sewerage and Drainage	3			
II. 6.	Power and Power Transmission			3	
VI. 15.	Concrete Structures	5			
VI. 20.	Hydraulic and Masonry Design	1	6	1	6
I. 11.	Geodesy			5	3
VI. 16.	Contracts and Specifications	2			
	Collateral Reading		24		12
	Thesis				15

DEPARTMENTS OF INSTRUCTION.

I. DEPARTMENT OF MATHEMATICS.

Constituting, as they do, the foundation of the several curricula offered by the School, the various subjects in mathematics are given first attention. The instruction has a double purpose: to cultivate in the student the faculty of independent reasoning, by practice in the development of formulas and other mathematical propositions; to make him familiar with the applications of these mathematical principles to the solution of such practical problems as may confront him in his professionol career.

The first year's work in the College assumes that the student has satisfactorily completed Courses 1 and 2 of this department. Students who have not completed these courses may pursue them in the Academy, but, on account of the number and sequence of the mathematical subjects required in the College, they are strongly urged to come prepared in the two subjects referred to.

1. Elementary Algebra.

The subject of quadratic equations and those algebraic subjects which usually precede it are studied, formulae are developed and problems are solved.

Time: Class-room, five hours a week, one year.
Text: Wentworth, *Elementary Algebra.*

2. Elements of Geometry. Professor DRAKE.

This includes both Plane Geometry and the Geometry of Space supplemented by numerous problems in demonstration, construction and computation.

Prerequisite: Course 1 of this department.
Time: Class-room, five hours a week, one year.
Tex: Phillip and Fisher, *Elements of Geometry.*

3. Descriptive Geometry. Professor SMITH.

The representation of all geometrical magnitudes by means of orthographic projection, the solution of problems involving points, lines, surfaces and solids, descriptions of and problems relative to warped and double-curved surfaces, intersections of lines and surfaces.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, first semester.

Text: Church, *Descriptive Geometry.*

4. Mechanical Drawing and Lettering. Professor SMITH.

This course comprises the drawing of 20 plates in the geometrical representation ot objects by isometric and ortographic projections. Objects in various positions are projected orthographically and the relations between the different views are brought out; sections at different positions and the intersections of solids are represented. The principles of linear perspective are discussed and applied to the representation of some simple objects.

The latter part of the semester is devoted to special practice in lettering and in the construction of appropriate and attractive letters for maps and engineering plans.

Prerequisite: Course 2 of this department.

Time: Laboratory, four hours a week, one year.

Text: Tracy, *Mechanical Drawing.*

5. College Algebra.

Quadratic equations, fractional and negative indices, imaginary and complex quantities, the progressions and other simple series, inequalities and limits, permutations and combinations, binominal theorem for any index, undetermined coefficients, exponentials and logarithms, terminants, and elements of the theory of equations.

Prerequisite: Course 1 of this department.

Time: Class-room, five hours a week, one year.

Text: Wentworth, *College Algebra.*

6. Trigonometry. Professor DRAKE.

A combination of the ratio and line systems is used, special attention being given to the transformation of trigonometric

expressions, solutions of trigonometric equations, and rigorous dealing with the fundamental series of trigonometry. Spherical trigonometry is also studied, the solution of spherical triangles and the application of spherical trigonometry to the simple problems of spherical astronomy being included.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, five hours a week, first semeter.

Text: Phillips and Strong, *Elements of Plane and Spherical Trigonometry.*

7. Analytic Geometry. Professor DRAKE.

The analytic geometry of the straight line, the circle, and the conic sections, is covered. The course includes also the transformation of co-ordinates, a discussion of the general equation of the second degree, and an introduction to the analytic geometry of space.

Prerequisites: Course 1, 2 and 6 of this department.

Time: Class-room, five hours a week, second semester.

Text: Ashton, *Plane and Solid Analytic Geometry.*

8. Calculus.

The subjects treated are the development of the basic principles and formulae of the calculus; differentiation of functions, development of functions into series, evaluation of indeterminate forms; maxima, minima, lengths of curves, areas, volumes, centers of gravity, and other applications of the methods of differentiation and integration to problems in geometry and analysis.

Prerequisites: Courses 1, 2, 5, 6 and 7 of this department.

Time: Class-room, four hours a week, one year.

Text: Osborne, *Differential and Integral Calculus.*

9. Mathematical Astronomy. Professor SMITH.

This course is intended to give the student practical knowledge of those principles of astronomy which are the foundation of geodesy. It comprises discussions of the sun, planets, satellites and stars, of their apparent motions and of the determination of their positions in the celestial sphere. Astronomical instruments, the sextant, transit, zenith-telescope,

altazimuth, their adjustments and uses, are explained. Special attention is given to the methods of determining latitude, time and azimuth.

Prerequisites: Courses 1, 2 and 6 of this department.

Time: Class-room, three hours a week, first semester.

Text: Barlow, *Mathematical Astronomy.*

10. Method of Least Squares. Professor SMITH.

Observation-errors and the determination of true value from numerous observations; residuals, weights, normal equations for determining average value; conditional observations, probable error, interpolation formulas.

Prerequisites: Courses 2, 5, 6, 7 and 8, of this department.

Time: Class-room, two hours a week, first semester.

Text: Johnson, *Least Squares.*

11. Geodesy. Professor SMITH.

The Earth, planets, satellites and stars, their astronomical positions and apparent motions, computation of right ascension and declination, description, adjustment and use of the sextant, astronomical transit, zenith-telescope and azimuth, and their applications to the determination of time and terrestrial latitude, longitude and azimuth.

Prerequisites: Courses 1, 2, 5, 6, 7, 8, 9 and 10, of this department.

Time: Class-room, five hours a week, second semester.
Field, three hours a week, second semester.

Text: Hayford, *Geodetic Astronomy.*

II. DEPARTMENT OF PHYSICS AND MECHANICS.

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1. **General Physics.** Professor NOBLE.

Mechanics, molecular physics and heat are studied.

The class work consiste of lectures, demonstrations, recitations and the solution of assigned problems.

The laboratory-work is so arranged as to exemplify the principles discussed in class and is quantitative in character, the qualitative experiments being performed in the class-room. The laboratory work consists of the following experiments: (1) Uniformly accelerated motion; (2) Relation of force to mass and to acceleration; (3) Composition and resolution of forces; (4) Moments; (5) Energy and efficiency; (6) Inelastic impact; (7) Elastic impact; (8) Young's modulus; (9) Moments of torsion and coefficients of rigidity; (10) Moment of inertia; (11) Simple harmonic motion; (12) Centripetal force; (13) Pressure-expansion of gases; (14) Heat-expansion of gases; (15) Archimedes's principle; (16) Calorimetry.

This course is intended not only to familiarize the student with the manner of making accurate determinations, of properly manipulating and adjusting the instruments used in making precise measurements, and of intelligently recording, interpreting and reducing the data obtained, but also to give him a better understanding of the laws of physics and of the real significance of physical constants.

Prerequisite: Course 6 of Department I.

Time: Class-room, five hours a week, first semester. Laboratory, three hours a week, first semester.

Texts: Millikan, *Mechanics, Molecular Physics and Heat.* Carhart, *University Physics.*

2. **General Physics.** Professor NOBLE.

A continuation of Course 1. Sound, light. electricity and magnetism are studied.

Prerequisite: Course 1 of this department.

Time: Class-room, five hours a week, second semester.

Text: Carhart, *University Physics.*

3. Analytic Mechanics. Professor SMITH.

Forces, first in their relation to each other; and second, the motions which they cause in the bodies to which they are applied, are treated.

In statics there are considered the composition, resolution and properties of concurrent and non-concurrent forces in equilibrium, centers of gravity, couples, and the statics of flexible cables.

In dynamics are studied: Bodies in motion; uniform, uniformly accelerated and variably accelerated rectilinear motions; falling bodies and impact; curvilinear motion; centrifugal force; pendulums and projectiles; moments of inertia, rectangular and polar; work, energy and power of motors; dynamometers and the measurement of power; friction and the transmission of power. A large number of practical problems relating to work, power and transmission are proposed for solution.

Prerequisites: Course 1 of this department, and Course 8 of Department I.

Time: Class-room, five hours a week, first semester.

Text: Church, *Mechanics of Engineering.*

4. Analytic Mechanics. Professor SMITH.

The mechanics of materials deals with the stresses and deformations produced in bodies of various forms and materials by forces variously applied; tension, compression of long and short columns and shear; flexure of beams, elastic curves and safe loads; continuous girders; introduction to Graphical Statics.

Prerequisite: Course 3 of this department.

Time: Class-room, four hours a week, second semester.

Text: Same as in preceding course.

5. Machine Design. Professor BRINSMADE.

The work is confined to such problems as a mining engineer is most likely to be confronted with. Lectures and recitations using Unwin's Machine Design, Part I, as a reference, are carried on. Problems in rivetted joints, in the use of structural steel and iron for long columns and girders and in the use of timber are assigned.

In the draughting-room drawings are made of the various parts of air-drills or of some other machinery in the department. The main object of this drawing practice is to familiarize the students with shop requirements in regard to such draughts and so that working draughts may become perfectly intelligible. The students are aided in this matter by sets of blue-prints which have been presented to the school by leading manufacturers of mining machinery. In the latter part of the course the problems taken up in the lectures are made the subject of the draughting-room work.

Prerequisite: Course 2 of this department, Course 3 preceding or accompanying.

Time: Class-room, two hours a week, second semester. Laboratory, four hours a week, second semester.

6. **Power and Power Transmission.** Professor BRINSMADE.

The various sources of power are discussed briefly, steam and other heat engines as the great sources of power being studied in considerable detail; the boiler and furnace with their accessories; the engine with its connections and controling mechanism.

Lectures are given on the transmission of power by shafting, gearing and compressed air; water-power and electric transmission and distribution of power; various types of electric generators, alternating and direct, and the transmission and transformation of electric energy.

Prerequisite: Course 1 of this department.

Time: Class-room, three hours a week, second semester.

Text: Hutton, *Mechanical Engineering of Power Plants.*

7. **Engine Laboratory.** Professor BRINSMADE.

Accompanying the lectures on the steam engine is the practice in the laboratory. The work varies from year to year, and excursions are also taken to plants where special features may be studied.

Time and character of work arranged.

8. **Hydraulics and Hydraulic Machinery.**

Professor SMITH.

Theoretical hydraulics, head and pressure velocity and path of a jet; instruments and measurements; practical for-

mulae; flow of water through orifices, weirs, tubes, pipes and open channels; losses of head, hydraulic gradient: nozzles, river-gauging, dynamic force of water; water-wheels, overshot, breast and undershot; turbines and impulse wheels; pumps, reciprocating and rotary, and pumping machinery.

Prerequisites: Course 3 of this department, Course 4 accompanying or preceding.

Time: Class-room, four hours a week, first semester.

Text: Merriman, *Treatise on Hydraulics.*

III. DEPARTMENT OF CHEMISTRY.

ROBERT PEELLE NOBLE, PROFESSOR.
———————— Laboratory Assistant.

The excellent equipment of the chemical laboratory (elsewhere described) makes it possible to offer a number of advanced courses essential to chemical engineering, in addition to those required by the curricula already outlined. These courses are designated *special* and will be given upon the request of a sufficient number of students.

It is the intention to secure as perfect a correlation as possible between the lectures, the quizzes and the laboratory-work, in order that the greatest efficiency in instruction may be attained.

1. General Chemistry, A.

This course is introductory to all engineering, metallurgical and geological courses and is intended to give the student a broad view of the field of inorganic chemistry by presenting to him the fundamental laws and theories of chemistry and by acquainting him with the occurrence, preparation, properties, relations and uses of the common non-metallic elements and of their compounds. With these substances, he performs in the laboratory as many experiments as the time permits, great weight being given to the making of neat and accurate records of these experiments and to the attainment of a scientific view-point. The time in the class-room is largely devoted to quizzes upon assigned subjects, ample opportunity thus being given to correct any erroneous ideas possessed by the student, and to add to his information on these subjects.

It is very desirable that one should be prepared with elementary physics before entering upon this course.

Prerequisite: Course 1 of Department I.

Time: Class-room, five hours a week, first semester.
Laboratory, nine hours a week, first semester.

Texts: Noble, *Elementary Chemical Theory.*
Newth, *Inorganic Chemistry.*
Remsen and Randall, *Chemical Experiments.*

2. General Chemistry, B.

This is a continuation of the preceding course and comprises a study of the metals in the same manner as the nonmetals are studied in Course 1. It is intended to be taken simultaneously with Course 3.

Prerequisite: Course 1 of this department.

Time: Class-room, three hours a week, second semester.

Text: Newth, *Inorganic Chemistry.*

3. Qualitative Analysis.

Those reactions which are used in the separation and detection of the metals of the silver group are carried out in the laboratory and discussed in the class-room. When sufficient familiarity with these reactions has been acquired, unknown solutions containing one or more metals of this group are then analyzed and the metals detected. The metals of the copper group are then studied similarly and unknown solutions containing the metals both of the silver and copper group are analyzed. In this manner the metals of all the groups are studied and finally the acids. When entirely familiar with the analytical procedure both for metals and acids, the student is required to analyze as many of the following substances as possible: Alloys, insoluble salts, industrial products, minerals, slags, mattes and speisses.

Prerequisite: Course 1 of this department. Course 2 must precede or accompany.

Time: Class-room, one hour a week, second semester.
Laboratory, six hours a week second semester.

Texts: Perkin, *Qualitative Chemical Analysis.* Fresenius, *Qualitative Chemical Analysis.*

4. Blowpipe Analysis.

Observations are made in the laboratory, of the flame-tests of the various metals and non-metals and of their compounds, of their behavior when subjected to the blowpipe-flame on charcoal and on plaster plates, with such reagents as are commonly used, and of their behavior when fused in the borax

and microcosmic beads. A number of unknown minerals are examined and their identification effected. The recording of all work and the submitting of such record at the completion of the course are required.

Prerequisites: Course 1 of this department. Course 2 must precede or accompany.

Time: Laboratory, three hours a week, second semester.

Text: Moses and Parsons, *Mineralogy, Crystallography and Blowpipe Analysis.*

5. **Quantitative Analysis.**

A course embodying the general principles of quantitative analysis and introductory to those courses involving special quantitative methods.

In the laboratory the following experiments are performed:

Gravimetric: Determinations of chlorin in a chlorid, of iron in iron wire or in ferrous ammonium sulphate, of sulphur in a sulphate, of phosphorus in apatite, of lead, copper (electrolytically) and zinc in brass, of silica in feldspar.

Volumetric: The preparation of half-normal solutions of an acid and of an alkali, the determination of the alkaline strength of crude oxalic acid, the determination of iron in an ore both by the permanganate and the bichromate method, the determination of the chlorin value of pyrolusite or of bleaching powder and the determination of silver in an ore by Mohr's or Volhard's method.

The class-room work consists in lectures on the use and care of balances, crucibles and desiccators, on the selection and use of indicators, on the use, care and calibration of volumetric flasks, burettes and pipettes, on the methods used in the laboratory from the standpoint of modern chemical theories, in quizzes on these topics and in the solution of stoichiometric problems involving calculations which are similar to those arising from, and essential to, the laboratory experiments.

Prerequisites: Courses 1, 2 and 3, of this department.

Time: Class-room, one hour a week, first semester.
Laboratory, nine hours a week, first semester.

Texts: Talbot, *Quantitative Chemical Analysis.*
Fresenius, *Quantitative Chemical Analysis.*

6. Fuel Analysis.

Analyses of various coals or of other fuels are made and their heat-values are then calculated from these analyses and also detərmined expermentally by means of the calorimeter. Flue gases are analyzed and the results are interpreted. The flash-point, burning point, specific gravity, viscosity, and acidity of oils are determined.

Lectures on the methods required for these determinations are given in the class-room.

Prerequisites: Courses 1, 2, 3, and 5, of this department.

Time: Class-room, one hour a week, first twelve weeks of first semester.
Laboratory, six hours a week, seven weeks of second semester.

Texts: Stillman, *Engineering Chemistry.*
Hempel, *Gas Analysis.*
Gill, *Oil Analysis.*

7. Water Analysis.

Analyses of waters are made in regard to their possible use in boilers. These analyses involve determinations of total solids, organic and volatile matter, silica, aluminum and iron, calcium, magnesium, sodium and potassium, and carbonic, sulphuric and hydrochloric acids.

Lectures are given on the methods require for these determinations, on the injurious action of certain waters on boilers and on the prevention of such action.

Prerequisites: Courses 1, 2, 3 and 5, of this department.

Time: Class-room, one hour a week, last five weeks of first semester.

Texts: Stillman, *Engineering Chemistry.*
Fresenius, *Quantitative Chemical Analysis.*

8. Wet Assaying.

A thoroughly practical course in the determination of the important constituents of ores and metallurgical products. The methods taught are those in use in the large smelters of the west. The student works upon checked samples of widely varying composition until he becomes familiar with

the various methods and can carry them out under all conditions with accuracy and rapidity.

A large collection of accurately checked samples are available for analysis, including many obtained from the principal smelters of the country. The regular work of the course consists in the assaying of typical ores and metallurgical products. By putting in extra time the ambitious student may greatly increase the number of his determinations and thus become decidedly more expert in this work.

The following determinations are made: sulphur, arsenic, silver, tin, copper (both by the cyanid and iodid methods), lead by the molybdate method, zinc by the ferrocyanid method, manganese and calcium by the permanganate method.

Lectures and quizzes are given on the methods employed in these determinations and on the reactions involved.

Prerequisites: Courses 1, 2, 3 and 5 of this department.

Time: Class-room, one hour a week, first semester.
Laboratory, six hours a week, first semester.

Texts: Furman, *Manual of Practical Assaying.*
Sutton, *Volumetric Analyses.*

9. Iron and Steel Analysis.

The analysis of pig-iron, wrought-iron and steel is undertaken, both accurate methods and rapid methods being considered. As many determinations of the following substances are made as the time permits: iron, sulphur, silicon, phosphorus, manganese, carbon both graphitic and combined, titanium, nickel, cobalt, chromium, aluminum and arsenic.

Prerequisites: Courses 1, 2, 3 and 5 of this department.

Time: Laboratory, three hours a week, one year.

Text: Blair, *Chemical Analysis of Iron.*

10. Rock Analysis.

The complete analysis of sedimentary, metamorphic and igneous rocks of complex mineralogical composition. Special stress is laid upon the determination of the minute quantities of metals such as lead, copper, gold and silver present in various types of rocks. Opportunity is given to carry on special investigations along these lines.

Prerequisites: Courses 1, 2, 3 and 5 of this department.

Time: Laboratory, six hours a week, second semester.
Texts: *Bulletin No. 148 of the U. S. Geological Survey.*
Fresenius, *Quantitative Chemical Analysis.*

11, Inorganic Preparations. (*Special.*)

Chemically pure substances of commercial importance are prepared by the student with constant attention to the securing of maximum yields. Skill in manipulation is encouraged, methods of manipulation not occurring in other courses are practiced, and a general increased knowledge of inorganic chemistry is acquired.

Prerequisites: Courses 1, 2, 3 and 5 of this department.
Time: Class-room, one hour a week, one semester.
Laboratory, six hours a week, one semester.
Text: Lengfeld, *Inorganic Preparations.*

12. Industrial Inorganic Chemistry. (*Special*)

The utilization of inorganic materials in manufacturing processes was taken up in an elementary way in connection with general chemistry. This special industrial course goes into the subject considerably more in detail. The manufacturing processes considered are mainly those of acids, alkalies, mineral dyes, mineral paints, explosives and matches.

The aim is to expound the dominant principles underlying each process rather than to present such an account of the details as will suffice for the student of any particular industry. In this manner the student is prepared to study efficiently the literature of any branch in which he may afterwards become especially interested.

Prerequisites: Courses 1 and 2 of this department.
Time: Class-room, two hours a week, one semester.
Text: Thorp, *Outlines of Industrial Chemistry.*

13. Organic Chemistry (*Special*).

This course serves as an introduction to the study of the hydrocarbons of both the fatty and the aromatic series, alcohols, phenols, aldehydes, organic acids, ethers, esters, and carbohydrates. Their formation, relations and derivatives are discussed, and special attention is given to the explanation of familiar organic phenomena.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, two hours a week, one year. Laboratory, six hours a week, one year.

Texts: Remsen, *Organic Chemistry.* Fischer, *Preparation of Organic Compounds.*

14. **Industrial Organic Chemistry** (*Special*).

The utilization of organic materials in the industrial arts is considered. The subjects taken up are: Petroleum and mineral oils, fats and fatty oils, essential oils and resins, cane-sugar, starch and its alteration products, fermentation, milk, vegetable textile fibres, animal textile fibres, animal tissues and their products, destructive distillation, artificial dyes, bleaching, dyeing and textile printing.

Special prominence is given to the petroleum and mineral oil industry, and to the destructive distillation of coal. The topics discussed under the first head are natural gas and its products, illuminating gas, fuel gas, lamp-black, and electric-light carbons, crude petroleum and its products, ozokerite and natural paraffines and their products, bitumens, asphalts, bituminous shales and their products, and vaseline. Under the destructive distillation of coal are taken up the varieties of coal, distillation in the gas-retort and in the coke-ovens, fractional separation of crude coal-tar, treatment of the ammoniacal liquor, light oil, middle oil, heavy oil, anthracene, pitch, and gas.

Prerequisites: Courses 1, 2, and 13 of this department.

Time: Class-room, two hours a week, one semester.

Text: Thorp, *Outlines of Industrial Chemistry.*

15. **Physical and Theoretical Chemistry** (*Special*).

The elements of theoretical chemistry have already been studied in the courses in general chemistry, qualitative and quantitative analysis. The subject is here pursued more exhaustively. The principal subjects considered are: The gas laws, atomic and molecular weights and the methods of determining them, forms and the phase rule, the kinetic theory, thermochemistry, ionization, dissociation and balanced actions, electro-chemistry and photo-chemistry.

Prerequisites: Courses 1, 2, 3 and 5 of this department.

Time: Class-room, two hours a week, one semester.

Text: Walker, *Physical Chemistry.*

IV. DEPARTMENT OF BIOLOGY.

The biological courses are offered in engineering mainly for two reasons. One is to enable the student to become somewhat familiar with the manipulation of the microscope and the preparation of material for examination, and at the same time to learn something of the minute structures presented by living forms, both animal and plant. The other is to enable the student to use the fossil organisms contained in the rocks as a guide geologically to locate himself.

1. General Biology.

The course offers a glimpse of the types of life. The simpler forms and the minute structure of the higher ones are studied by means of the microscope. As the main object is to give the student an idea of the broader distinctions of the main groups of plants and animals, the survey covers with some detail a few forms rather than imperfectly a large number of species. A large number of carefully selected slides are already available for histological purposes.

Prerequisite: Courses 1 and 2 of Department III.

Time: Class-room, one hour a week second semester.
Laboratory, three hours a week, second semester.

Text: Dodge, *Practical Biology.*

2. Paleontology.

A brief view of the fossils is taken with special reference to the geological succession in Southwestern United States. Characteristic types of each of the geological periods are studied with care. The methods of determining geological horizons by means of fossils are discussed and allusion made to geological correlations.

Advanced study is offered to those desiring to take the subject as a main theme. The New Mexican field is very inviting. Details and time will be arranged.

Prerequisite: Course 1 of this department and Course 3 of Department VII.

Time: Class-room, two hours a week, one year.
Laboratory and field, three hours a week, one year.

Text: Zittel and Eastman, *Paleontology.*

3. **Hygiene and First-Aid.**

Lectures by local physicians on the laws of health and on the "first-aid" treatment of accidents. These lectures will be given at such times as will suit the convenience of the lecturers.

V. DEPARTMENT OF LANGUAGES.

EMMETT ADDIS DRAKE, PROFESSOR.

A speaking knowledge of Spanish has recently become a great advantage, if not a necessity, to a large percentage of the young men who engage in any of the lines of work for which they may fit themselves at the School of Mines. For that reason special attention is given to the study of the language at this institution. The course offered continues through two years and is designed to give the student a practical speaking knowledge of Spanish. The location of the New Mexico School of Mines affords an unsurpassed opportunity for acquiring this knowledge, for in Socorro and vicinity Spanish is as generally spoken as English.

Either French or German may be taken in place of Spanish if a sufficient number of students apply.

The courses in German continue through two years. No particular attention is given to the speaking or writing of this language. The chief aim is to put the student into possession of a useful instrument for his major line of work.

The importance of a reading knowledge of both German and French cannot emphasized too strongly, as a vast store of information necessary to the engineer and scientist is locked up in these languages. By the end of the second year the student should be able to read readily the scientific and technical books which are of use to him in his work.

The courses offered in French continue through two years. The chief aim in this course, as in the course in German, is to give the student such a reading knowledge of the language as will be of practical use to him in the pursuit of his special line of work. The student is expected to be able at the end of the course to read French with sufficient ease to use French text-books and other publications in the pursuit of his technical studies.

1. Spanish.

The work is based on Worman's First and Second Spanish Readers. A part of the class exercises each day consists in cross-translations, both oral and written. Special stress is placed upon conversational exercises. Attention is given to the elementary principles of the grammar of the language, especially to conjugation.

Time: Two and a half hours a week, one year.

Texts: Worman, *First* and *Second Spanish Readers.*
Garner, *Spanish Grammar.*

2. Spanish.

Alarcon's El Capitan Veneno and Valera's El Pajaro Verde are read. The study of Spanish Grammar is pursued systematically, Garner's Spanish Grammar being used as a text. Two periods each week are devoted to conversation in Spanish and to cross-translation, no particular text-book being used in this work.

Prerequisite: Course 1 of this department.

Time: Two and a half hours a week, one year.

3. German.

The first year's work in this course is elementary. It consists of a study of grammar and easy readings. Practice in speaking and writing the language is not insisted upon any further than it many be an aid in fixing the main principles of construction in the mind. However, opportunity to acquire a speaking knowledge of German is afforded to such students as may so desire.

Time: Two and a half hours a week, one year.

4. German.

The second year's work in German consists in the reading of narrative and descriptive modern prose and a drama of Lessing or Schiller. The study of grammar is continued. Sight-reading forms a large part of the exercises of the exercises of the second term. The reading texts are changed from year to year to avoid repetitition and to give students who may desire to do so an opportunity to take more than the required amount of German.

Time: Two and a half hours a week, one year.

5. French.

The first year's work is elementary. Otto's French conversation Grammar and Le Roman d'un Jeune Homme Pauvre form the basis of the work. The text-book for reading is changed from year to year, however, to give students who may wish it an opportunity to read more than the required amount of French. Easy reading are assigned for work outside the class-room with a view to examination.

Time: Two and a half hours a week, one year.

6. French.

Effort is still concentrated upon reading. The student is expected to be able at the end of this course to read with sufficient ease to make practical use of French text-books and periodicals in this other studies. The study of grammar is continued. La Petite Fadette, Le Cid, Le Misanthrope and Athalie are the texts from which the readings are selected.

Time: Two and a half hours a week, one year.

VI. DEPARTMENT OF CIVIL ENGINEERING.

OLIVER RUSSELL SMITH, PROFESSOR.

In Civil Engineering the first three years are devoted to the mastery of those sciences upon which all professional engineering practice is based. In addition to a thorough mathematical training, particular care is taken to familiarize the student with the construction, care and use of engineering instruments. To this end, in addition to the regular class-room work, much time is given to field work, wherein a great variety of practical problems are treated. Attention is also given to the study of engineering materials and their adaption to various structures.

In the post-graduate work of the fourth year the student is offered several branches in which he may specialize. These are Structural Engineering, Sanitary Engineering, and Hydraulic and Irrigation Engineering. The work of this year is largely drawing and design, intended to prepare the student for practice along one of these lines.

The School offers great advantages in the line of Hydraulic and Irrigation Engineering. Besides being situated in a distinctly irrigation country, it is also in reasonable proximity to two of the largest projects of the United States Reclamation Service, where the latest and best methods may be studied.

In the summer field-excursions are worked out various problems which, because of their location and also from lack of time, could not be considered during the school year. Students have usually been able to attach themselves during the summer vacation, to the regular surveying parties of railway, irrigation or mining companies, the United States Land Office or the United States Geological Survey.

1. General Surveying.

The introductory course in Surveying deals with the principles of land-surveying, the instruments used both in the

field and in the office, their adjustments and their proper care. The transit, level, solar compass, and plane table are discussed in detail and their uses in the various problems of land-, mine-, and hydrographic surveying are illustrated by numerous practical problems and field exercises.

In the field-practice each student becomes thoroughly familiar with the laying out with compass and chain of small land holdings, the survey of urban lots and streets by means of transit and steel-tape, location of mining claims, and similar work. Observations are made on the polar-star for the purpose of determining the true meridian. Latitude, azimuth and time by direct solar observations are determined. Triangulation, both primary and secondary, from a measured base-line is carefully worked out. Measurements are made of mountain heights by triangulation methods. The various methods of topographic mapping are considered in detail.

Prerequisites: Courses 1, 2 and 6 of Department I.

Time: Class-room, three hours a week, second semester.
Field, four hours a week, second semester.

Text: Johnson, *Theory and Practice of Surveying.*

2. Plotting Surveys.

Each student makes a complete map or plat of the surveys made during the progress of the summer field-work and of all the surveys made by him during the school year. Bearings or azimuths of courses are laid off both by protractor and by co-ordinates and errors in closure are discussed and illustrated. In general, areas are computed by latitudes and double meridian distances.

Prerequisites: Course 1 of this department.

Time: Laboratory, two hours a week, second semester.

3. Free-Hand Drawing.

It is expected that during the first year the student will acquire considerable skill in drawing, preparatory to the special training of later years. Particular attention is given to free-hand work in order to enable the student to make, readily and rapidly, intelligent sketches of all ordinary objects, simple machines, diagrams of engineering works and geological structures. A study of light and shade and of

perspective is made, and pencil-and-pen drawings from various models are executed, the proportions being obtained by making measurements of the object "pencil in hand." Landscape sketching is practiced.

Time: Three hours a week, first semester.

4. Mine Surveying.

The work consists of lectures, field-practice and office-work. The field-practice embraces both surface location of claims and top-works, and the underground excavations.

In the location of mining claims a complete survey is made for the purposes of patenting, in accordance with the requirements of the Surveyor General's Office. It includes all the methods followed by United States Mineral Surveyors. The law relating to surveys for the patenting of mining properties is treated in detail.

In the underground surveying, particular attention is given to physical difficulties met with and unusual obstacles to be overcome. Among the special topics that are dwelt upon at length are the location of underground stations, connection of surface and subterranean workings through slopes and shafts, graphic methods of keeping notes, preparation of mine-maps by method of co-ordinates, preservation of maps and permanent records.

In the field-practice several mines of different types are surveyed, full notes taken and maps made. This work is supplemented by summer practice of still more extended character.

Prerequisite: Course 1 of this department.

Time: Class-room, two hours a week, first semester.
Field-practice and office-work, four hours a week, first semester.

Text: Johnson, *Theory and Practice of Surveying.*

5. Railway Surveying.

Under this head is studied the location of a railway under the three natural divisions of Reconnoissance, Preliminary Surveys, and Location Surveys, with the methods and instruments adapted to each. The theory of economy in grades

and curves is considered at some length and the principles of simple and compound curves treated.

Practice is given in locating curves and tangents, levelling, plotting, establishing grades, constructing profiles, cross-sectioning, estimating volumes of fills and cuts, location of piers and bridge abutments, and laying out of switches.

Prerequisite: Course 1 of this department.

Time: Class-room, three hours a week, second semester.
Field, six hours a week, second semester.

Texts: Johnson, *Theory and Practice of Surveying*. Searle, *Field Engineering*.

6. Topographical Drawing.

The topographical survey made in the summer is plotted, all contour lines, streams, roads, fences and buildings being properly shown. The nature of the soil and vegetation is indicated by the conventional topographical symbols, thus making a complete and accurate map of the area surveyed. In plotting stadia work, special attention is given to rapid methods of reducing and plotting inclined stadia readings. The mechanical reproduction of maps to different scales and the evaluation of irregular areas are discussed.

Prerequisite: Course 1 of this department.

Time: Laboratory, two hours a week, second semester.

7. Roads and Pavements.

A brief discussion, from an engineering standpoint, of the principles involved in highway work under the following divisions: Economic importance and characteristics of good highways, location, construction, drainage, improvement and maintenance of country roads, various paving materials, broken stone, brick, asphalt, wood and stone blocks, and concrete, foundations for and adaptability of each, arrangement and details of city streets.

Prerequisite: Course 1 of Department II.

Time: Class-room, two hours a week, second semester.

Text: Spalding, *Roads and Pavements*.

8. Masonry Construction.

The lectures treat chiefly of the following subjects:

(1) Materials used in masonry construction, under the

heads of stone, brick. lime, cements, wood, iron and steel. Special emphasis is placed upon the geological occurrences of the suitable materials and methods of testing.

(2) Foundations; open trenches, pile foundations, foundations under water, cofferdams, cribs, pneumatic and other methods.

(3) Dams; brush-cribs, framed timbers, masonry and rock fills.

(4) Retaining wall, bridge abutments and bridge piers.

(5) Culverts, wood, pipe and stone arches.

Prerequisite: Course 1 of Department II.

Time: Class-room, three hours a week, second semester.

Text: Balser, *Treatise on Masonry Construction.*

9. Sanitary Engineering.

An elementary course in sanitary science dealing with the drainage of building and lands, disposal of house sewage, water carriage systems, storm sewers; also the heating, plumbing and ventilation of buildings both public and private.

Prerequisite: Course 1 of Department II.

Time: Class-room, two hours a week, first semester.

Text: Merriman, *Sanitary Engineering.*

10. Railway Location.

This course presents the economic phases of railway location and construction. The causes which affect the gross receipts of a road, the cost of construction and the operating expenses are fully discussed, and the relative importance of each considered in detail. True and false economy in construction, and kindred topics are entered into at length.

Prerequisite: Course 1 of Department II.

Time: Class-room, three hours a week, second semester.

Text: Wellington, *Economic Theory of Railway Location.*

11. Stresses in Frame Structures.

The application of the laws of forces in equilibrium to the computation of the stresses in various kinds of frame structures; the method of moments; the method of resolution of forces; loads on a roof truss; dead-, snow- and wind-loads;

changes in length due to changes in the temperature; highway bridges, dead loads, moving loads, snow and wind; applications to different forms of truss; railway bridges, dead loads, moving loads; snow, wind and impact; shear and bending moment; double and multiple truss systems; deflection of bridges. Numerous practical problems are presented for solution.

Prerequisite: Course 3 of Department II.

Time: Class-room, three hours a week, second semester.

Text: Merriman and Jacoby, *Roofs and Bridges*, *Part I.*

12. Graphical Statics,

In this course the graphical methods of solving problems relating to forces in equilibrium are considered in detail. These methods are based upon the representation of forces in amount and direction by straight lines, the properties of force-polygons and equilibrium-polygons, moment and shear diagrams. Special attention is given to the application of these methods to the stresses in various framed structures.

Prerequisite: Course 3 of Department II.

Time: Class-room, three hours a week, second semester.
Laboratory, five hours a week, second semester.

13. Structural Details, A.

Practical applications of the principles of stresses in the design and proportioning of the various parts of engineering structures, dams, arches, roofs, and bridges.

Special attention is given to designing long columns and to the connections of the members of a structure.

Prerequisite: Courses 11 and 12 of this department.

Time: Class-room, two hours a week, one year.
Laboratory, six hours a week, one year.

Text: Merriman and Jacoby, *Roofs and Bridges*, *Part III.*

14. Structural Details, B.

More advanced work in continuation of Structural Details A, in which are considered steel mill and office buildings, cantilever and draw bridges, steel arch ribs and concrete arches.

Prerequisite: Course 11 of this department.

Time: Class-room, two hours a week, one year.
Laboratory, nine hours a week, one year.
Text: Merriman and Jacoby, *Roofs and Bridges, Parts III and IV.*

15. Concrete Structures.

This course deals with the desigining and construction of reinforced concrete structures, the materials used and the methods employed; the properties of concrete and steel, practical formulas for the computation of all classes of structures, illustrations and descriptions of a large number of representative structures, properties of and methods of testing the materials used, various types of reinforcement, forms, facing and finishing.

Prerequisite: Courses 3 and 4 of this department.
Time: Class-room, five hours a week, first semester.
Text: Buel and Hill, *Reinforced Concrete.*

16. Contracts and Specifications.

Lectures on the laws governing contracts and their special applications to engineering construction; approved forms of specifications for various structures.

Time: Class-room, two hours a week, first semester.
Text: Wait, *Law of Contracts.*
Various standard specifications for reference.

17. Water Supply.

The design, construction and maintenance of municipal water supply systems, under the following divisions: sources and requisites of a water supply, methods of collecting, storing and distributing water, the flow of water in various kinds of conduits, storage reservoirs, analysis and purification of public water supplies, pumping systems, maintenance of quantity and quality of supply, maintenance of storage and distribution works, house connections, meters and waste of water.

Prerequisite: Course 8 of Department II.
Time: Class-room, three hours a week, second semester.
Text: Folwell, *Water-Supply Engineering.*

18. Sewerage and Drainage.

A study of the quantity of house sewage and storm waters, the proper shape and dimensions of conduits for water carriage systems; sewer ventilation and flushing, office of man-holes, flush tanks and other details of contruction; location of outfall, final disposal of sewage, sewage irrigation, filtration, septic treatment, cremation of refuse.

Prerequisite: Course 8 of Department II.

Time: Class-room, three hours a week, first semester.

Text: Folwell, *Sewerage.*

19. Irrigation Engineering.

The condition governing, and the extent and commercial value of the irrigation of arid lands in this and other countries, sources and requisites of a supply of water for irrigation, difficulties and harmful effects of irrigation, flow and measurement of water, duty of water, storage, distribution and application of water, together with a brief description of the structures appropriate to each division of the process.

Prerequisite: Course 8 of Department II.

Time: Class-room, three hours a week, first semester.

Text: Wilson, *Manual of Irrigation.*

20. Hydraulic and Masonry Design.

This course is chiefly field and drawing-room work in the preparation of plans and specifications for a municipal water supply, a sewer system or an irrigation system, at the option of the student, the data on which to base the design being collected by the student himself.

Prerequisite: Courses 17, 18 or 21, as the case may be.

Time: Class-room, one hour a week, one year.
Laboratory and field, six hours a week, one year.

21. Irrigation Structures.

A detailed study of the various classes of structures necessary for the impounding, distribution and application of water for irrigation purposes, with descriptions of numerous examples of the various types of dam used (especially those used in American practice), masonry, rock and earth fills and timber cribs, storage capacity and sedimentation of reser-

voirs, waste-ways, diversion weirs and head works, distribution systems, canals, lined and unlined, tunnels, flumes and aqueducts, water power in connection with irrigation systems.

Prerequisite: Course 19 of this department.

Time: Class-room, two hours a week, second semester.

Texts: Schyler, *Reservoirs for Irrigation.*
Flynn, *Irrigation Canals and Other Irrigation Works.*

22. Summer Field-Work.

During the summer surveying parties are organized, comprising all undergraduate students and others, for a period of about four weeks. The field practice is continuous in the various branches of surveying. These parties camp in localities convenient to their respective lines of work.

The first-year men are assigned a township of land which they subdivide in accordance with the instructions of the United States Land Office, and make a topographical map by the transit and stadia and plane-table methods. Of the upper-class men the students of Mining Engineering make complete surveys and construct maps of important mines; while the Civil Engineering students locate a railway from five to ten miles in length, according to conditions, and also make complete surveys, maps and estimates for an irrigation system.

Each year students are usually able to secure employment for the summer with regular surveying parties and receive encouragement in this in every way possible.

23. Journal Club.

A fortnightly gathering of engineering instructors and students, at which current literature is read and discussed.

VII. DEPARTMENT OF MINING GEOLOGY.

CHARLES ROLLIN KEYES, PROFESSOR.

The organization of this department, having for its special purpose instruction concerning ore-bodies and their relations to geological structures, is founded on the belief that the proper knowledge of this branch of mining contributes equally as much to the success of any enterprise as a knowl edge of mechanical mining methods, or what is most generally understood by mining engineering. The proper geological consideration of the materials sought after in mining, vastly promotes mining both generally and specifically by putting each proposition upon a more strictly business basis. Prospecting is more rationally conducted. Exploration is more confidantly carried on. Exploitation is systematically productive. The element of chance is very largely eliminated.

For the most part the work in these courses is laid out with reference to the mining aspects of the subject. Great importance is attached to field-work and for this work the facilities offered by the neighborhood are nowhere else surpassed.

1. Descriptive Mineralogy.

(a.) Crystallography. This particular division of physical mineralogy, dealing with the geometrical forms in which minerals crystallize, is thoroughly studied. The different crystal systems are considered in turn and constant practice in the reading of crystal forms is given by means of a complete collection of wooden and celluloid models and also from specially selected natural crystals. The subjects of twinning, hemihedrism, tetartohedrism, hemomorphism and like topics are studied in detail.

In the laboratory the projection of crystal forms is carried on, and clinographic projections made of the principal types in the several systems. In addition to this, zone-control and the determination of the indices of unknown planes lying in

two or more zones are explained and problems assigned. Exercises in orthographic, clinographic and spherical projections forms an essential part of the laboratory work.

Frequent reference is made to Dana, Nauman and Miller, and the symbols used by each are mastered.

Prerequisites: Courses 3 and 4 of Department I.

Time: Class-room, three hours a week, first twelve weeks of first semester.

Laboratory, three hours a week, twelve weeks.

Texts: Williams, *Elements of Crystallography.*

Miers, *Mineralogy.*

(b.) Physical Mineralogy. The subjects of hardness, cleavage, color, specific gravity, etching and thermo-electric properties, optical characters and the like are carefully considered. The special study of optical properties and of the actions of crystals on transmitted light is deferred, however, until petrography is studied.

Prerequisite: Course 1 (a) of this department.

Time: Class-room, three hours a week, last five weeks of first semester.

Laboratory, three hours a week, last five weeks of first semester.

2. Determinative Mineralogy.

Specimens of minerals from the large collections of the School and also those collected on field excursions or sent into the laboratory are examined and identified by the student, the crystal form, the physical and chemical properties and thə paragenesis of each mineral being carefully studied. Special emphasis is given to acquiring familiarity with a large number of such mineral species as occur in mining regions and with the associations in which they are likely to be found. The order of study followed in the lectures is: the elements, sulphids, selenids, arsenids, tellurids, antimonids, sulphosalts, haloids, oxids, oxygen-salts, salts of the organic acids and hydrocarbons. Much of historic interest is given in the lectures, and gems and precious stones receive considerable attention. Collateral reading is required on the important species.

Weekly quizzes, monthly reviews and other practical exer-

cises supplement the daily lectures and serve to broaden the student's training, as well as to fix in his memory the various distinctions between mineral species. The relative values of each mineral, both from the standpoint of economic use and its worth for mineral collections, are clearly and fully set forth.

Prerequisite: Course 1 of this department and Courses 1 and 2 of Department III.

Time: Class-room, three hours a week, second semester.
Laboratory, three hours a week, second semester.

Texts: Dana, *Systems of Mineralogy*
Miers, *Mineralogy*,
Moses and Parsons, *Mineralogy, Crystallography and Blowpipe Analysis.*

3. Principles of Geology.

All of the training in geelogy is arranged with special reference to professional work. There are three main classes of students to which the courses have been particularly adapted. The first class embraces those whose occupations are to be closely identified with mining. A second class includes those who look forward to employment of a more or less public character, such as is afforded by private, State and Federal geological surveys. A third class aims to embrace students who expect to follow, in part at least, the pure science of geology, or to be connected with the economic and technical departments of higher educational institutions.

The instruction is conducted by means of lectures, recitations, laboratory examinations and frequent excursions into the field and is designed to familiarize the student with the data of geology. Materials composing the earth, the soils, rocks, minerals, ores, fossils and earth-forms, receive the attention they deserve as fundamental elemcnts. The processes and conditions of geology are considered in their different aspects. The laws and methods of interpretation of phenomena are discussed with considerable detail. The mental operation of observation, generalization, suggestion of hypothesis, formulation of theory and proof of geological doctrine are explained and the importance of properly considering them in all scientific work is emphasized.

Features illustrating a large variety of geological phenomena are well displayed in the neighborhood of the School and afford excellent opportunities for field-work. The old Socorro volcano, rising 2,500 feet above the campus, presents many types of rocks, and many structures associated with volcanic districts. Lemitar mountain, six miles away, affords other phenomena of vulcanism. Faulting, folding, jointing and their associated features, are well displayed. The sedimentaries are well represented from the paleozoics to the most recent. The phenomena of erosion, and the development of geographic forms are almost unique. With all these illustrations at the very door of the School the student is never at a loss for something interesting and new.

Excursions are made, mines are visited and the student is instructed in the art of taking notes, and of making sketches and maps. He subsequently writes out a full, but concise report of his observations, which is critically examined in all its aspects by the instructor in charge. These reports are then talked over in class, and the shortcomings noted and corrected.

An outline of the course is furnished by syllabus, with frequent reference to the principal text-books on geology.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room three hours a week, one year.
Field, three hours a week, one year.

4. Economic Geology, A.

The subject is taken up according to the different metals commonly mined. The principal deposits of this country are discussed in all their different aspects and the uses of each, their geological peculiarities; and the special methods of working each are considered. The leading foreign occurrences are also taken up.

A syllabus is followed in the general treatment. Constant reference is made to Kemp's "Ore Deposits of the United States and Canada," Tarr's "Economic Geology of the United States," Fuchs and De Launey's "Traite des Gites Mineraux et Metalliferes," Von Cotta's "Die Lehre von den Erxlagerstaetten." Frequent references to original sources of information are also made.

The various iron ores are first taken up. These are followed by a consideration of the ores of lead, zinc, silver, gold and then the rarer and less important metals. The different combinations of these several ores are also described. The relations of the ore-bodies to the geological formations and structures are especially emphasized.

Prerequisite: Course 3 of this department must precede or accompany.

Time: Class-room, two hours a week, first semester.

5. **Economic Geology, B.**

The subject is treated with much greater fullness than is usually apportioned to it in the works on economic geology. A syllabus is used, supplemented by copious references to the original sources of information, and instruction is given with special reference to the engineering aspects of the materials, the uses and the methods of mining and preparing the raw substances for the market.

The fuels are considered with special reference to their value as steam producers, their manner of occurrence and the geological structures determining their accessibility.

The building stones are not only treated with regard to their physical and chemical properties, but special attention is paid to their microscopical characters. The intrinsic qualities and external conditions affecting the durability of stones used in engineering constructions are gone into in detail. The comparative durability of different kinds of stones is considered both by means of tables and by systematic testing. Tne means of artificially preserving building stones are described. Methods of quarrying and the use of machinery in quarrying all come in for adequate treatment.

Cement materials, limes and gypsum are especially considered, together with the means adopted for testing them.

Soils, fertilizers and road metals are described as to their geological occurrence and their properties.

Each of the minor mineral substances used in construction or in the arts is given the consideration it deserves.

Prerequisite: Course 3 of this department must precede or accompany.

Time: Class-room, two hours a week, second semester.

6. Dynamical Geology.

A detailed consideration of the dynamic agencies involved in the geotectonic and geographic evolution is given. The general scheme followed is genetic in character, as given in Keyes' "Genetic Classification of Geological Phenomena." The fundamental principle recognized is that the processes and not the products are made the central theme. There is thus always presented the underlying relationship of cause and effect. All products find accurate expression in terms of the agencies.

The agencies affecting rock-masses as a whole are discussed in all their various aspects. Models, photographs, other illustrations, and examinations in the field, all contribute to an understanding of the various phenomena commonly met with. Subterranean waters, the conditions governing their movements, and the capacities for transporting metallic substances in solution are treated in considerable detail. The causes of formation and the phenomena presented by mineral-veins and ore-bodies are given particular attention.

Volcanic activity and the influence of such conditions upon the rocks which come in contact with intruded masses of molten rock are fully described and copiously illustrated by examples drawn from New Mexican localities, and from other easily accessible localities. New Mexico is very rich in phenomena of this kind and the field is practically a virgin one.

Prerequisite: Course 3 of this department.

Time: Class-room, three hours a week, first semester.
Field, four honrs a week, first semester.

7. Structural Geology.

Thoughout the entire course the mining aspects of the subject are kept constantly in the foreground. The intimate relationships which the structures exhibited by rock-masses bear to the economic deposits associated are especially emphasized.

The simpler phenomena of stratification are fully explained and illustrated. The various processes involved in the formation of sedimentary rocks and the conditions under which the latter are deposited are described morein detail than was

possible under Dynamic Geology. Sedimentation itself is followed in all the various phases of transportation and deposition of land-waste. Discussion of the factors which should guide the interpretation of the sedimentary record, forms an important part of the course.

Joint-planes, tiltiing of strata, the folding, crumbling and crushing of rock-masses are amply illustrated from New Mexican sources. Cleavage, faulting and the relationships of eruptives are explained. Dikes and mineral-veins are especially dwelt upon.

Collateral reading and interpretation of geological maps constitute an integral part of the work.

Prerequisites: Courses 3 and 6 of this department.

Time: Class-room, three hours a week, second semester.
Field, four hours a week, second semester.

8. Stratigraphical Geology.

The main purpose of the course is to enable the student to get a connected idea of the history of the earth. The biotic features of the various periods are illustrated by the most important type forms of life. Practice in determining fossils and in interpreting their character is designed to familiarize the student with the common principles of stratigraphy.

The economic value of fossils is commonly entirely overlooked. Often even a slight acquaintance with the true character of fossils enables the rocks to be read as a printed page. It is one of the best established facts in modern geological science that there is an intimate relation existing between mineral deposits and the surrounding rocks; hence the geological age of the particular beds becomes an important factor in the early attempts to develop new mineral districts. This suggestion again rests upon one of the cardinal principles of geology: that the geological succession of strata is determinable readily by the remains of life contained. Thus, in realty, fossils are labels on the rocks, telling one at a glance the age of the bed that he is working, and providing him with the most reliable guides he could possibly secure to direct him to the layers most likely to contain the mineral sought.

The range and geographic distribution of the geological formations are discussed, and their important local facies

described. Their characteristic features in the Rocky Mountain region are dwelt upon in considerable detail. Maps, charts, models and other illustrative materials are critically examined. The construction of geological sections is explained. Actual work along this line is undertaken under the supervision of instructors.

Prerequisites: Courses 3 and 6 of this department.

Time: Class-room, three hours a week, second semester.
Field, simultaneous with preceding course.

9. Practical Geology.

This course is intended to give a working knowledge of the actual field methods in geological inquiry. There are taken up some of the leading criteria of geological discrimination, the foundations of classification and the manner of working towards the attainment of tangible and definite ends.

The collection of material and apparatus is only incidentally touched upon. The methods of work in the indoor laboratory are passed by altogether.

The practical analysis of geological phenomena is viewed from the standpoint of the geological survey. This, in its modern development, embodies the most exact adjustment possible of actual field-work, laboratory examination and comprehensive deduction. Each problem is attacked from a number of different view-points; separate lines of investigation are focused upon every question.

Special stress is placed upon those particular phases of practical field-work in geology which experience and consultation have oftenest shown are those to which greater attention should be paid than is usually the case. They are phases in which nearly all persons entering the field of independent geological inquiry have to be instructed before they are able to accomplish the tasks demanded of them.

Among the various themes discussed are the equipment for field-work, the methods of geological mapping, the determination of rocks and rock-masses, the attitude of rock-masses, the deciphering of original geological structures, the dissection of acquired geological structures, geological classification, investigation of massive crystalline masses, crystalline

schists, and the sedimentaries, and the application of geological principles to the exploitation of mineral deposits.

Prerequisites: Courses 1, 2 and 3 of this department.

Time: Class-room, one hour a week, first semester.

10. Topographical Mapping

A course in topographical mapping in accordance with the methods followed by the governmental bureaus of all civilized nations. The methods of the United States Geological Survey in particular are fully considered and ample field practice afforded. The relations of geologic structure to topographic expression are discussed, numerous practical illustrations explained and examined on the ground. All factors entering into the preparation of an adequate topographic base for exact geologic mapping of rock-masses and the proper representation of geologic structures are viewed in their different aspects and the construction of a suitable topographic base-map is carried out in a practical way. The various methods are considered in detail and the advantages and shortcomings of each under different conditions are discussed and compared. Practice in primary triangulation and secondary triangulation and the filling in of the larger triangles by plane-table methods is made a feature. In putting in the topography the contour method is chiefly adopted, and particular attention given to the morphogenic expression of earth sculpture.

Students may select prescribed areas of 25 square miles each in which there is a great diversity of surface relief and geologic formations and may be given every opportunity to perform all the work with proper supervision, as a part of a comprehensive scheme for mapping the region which the School has begun. For this work credit is given both on the published map and in the accompanying printed reports.

Prerequisites: Course 3 of this department and Course 1 of Department VI.

Time: Field and laboratory, six hours a week, first semester.

11. **Geological Surveying, A.**

The methods are those followed by the National and State Geological Surveys, and the work is especially adapted to those students who are looking forward to investigations of a public character.

Part of the training in geological surveying is obtained in pursuance of the more advanced courses in geology and in tne study of mineral deposits. In these courses it is expected that the student will have acquired something of the art of making topographic base-maps in which the local facial expression of the earth is recognized as due to the underlying rock-structure, of sketching in the formations and of intelligently constructing geologic cross-sections.

In the special course the work is taken up in a thoroughly practical way. The student becomes a part of the corps connected with the Geological Survey. He works in conjunction with others towards ends indicated by a general policy such as governs public sciontific investigation. The chief aim is the preparation of a way for intelligent guidance in the search for mineral wealth. The constant tendency is towards the commercial aspects of the subject. The organization of a geological survey has many features which may be regarded as peculiarly its own. The public character of the survey and its support as a public institution impose duties upon it that are unknown in private scientific and expert work. Training is not only entered into under new conditions, but the student receives instruction in the administrative and organizing duties of the survey. As contributing to the success of the organization as a whole, these phases are as fundamentally important as the more purely scientific efforts. Consideration of many and diverse lines of work is an important element.

Prerequisites: Courses 1, 2, 3, and 10 of this department.

Time: Class-room, one hour a week, second semester.
Field, six hours a week, second semester.

12. **Geological Surveying, B.**

A continuation of the preceding course.

Prerequisite: Course 11 of this department.

13. Petrography.

As introductory to this course, optical mineralogy is first studied, particular attention being given to the subject of polarization, optical constants and the effects produced by thin sections of various minerals between Nicol prisms both in parallel and in converged light.

The principles thus studied and the differences observed are then used by the student to extend his acquaintance with the various types of rock in the form of mineral aggregates as well as in the form of individual crystals. The appearance which the igneous rocks present when viewed in thin sections under the microscope are from the first gone into rather exhaustively. The lectures take up the simpler granites and, in order, the rest of the acidic series, then the members of the intermediate series, the basic series and finally the small group of the ultra-basics. With the last mentioned series, the celestial rock-types are briefly treated.

Particular attention is paid to the alteration of minerals in rocks, as disclosed by the microscope, for the reason that the subject has such an important bearing upon rock metamorphism in general and the formation of ore-bodies in particular.

The subject of the separation of rock constituents by means of heavy solutions and the microchemical reactions are entered into with considerable detail.

Each student is required to identify a number of samples of rock by preparing thin sections from them and subjecting these sections to microscopical examination.

Prerequisites: Courses 1 and 2 of this department and Course 2 of Department II.

Time: Class-room, three hours a week, one year.
Laboratory, six hours a week, one year.

Text: Rosenbusch *Mikroskopische Physiographie der petrographish wichtigen Mineralie.*
(translated by Iddings.)

14. Ore Deposits.

(a) Genesis of Ore Deposits.

The instruction in this subject is essentially in the principles of ore deposition.

The subject is treated by lectures, supplemented by copious references to the literature. Numerous field inspections are necessary and it is advised that this branch of the work be made as extensive as possible. In addition to the regular class excursions, which take place on Saturdays and in vacation times, individual inspections are recommended. An important part of this work will be succinctly written reports of what has been seen.

Among the main general topics treated of in the lectures are: The distinguishing characters of ores, an outline of the geological terranes, the geological structures especially connected with ores, the geology of ore deposits (as space fillers or geological formations), the conditions governing ore deposition, the character of ores, the mineralogy of ores, the structural features of ore-bodies, rock alteration and its relation to ore formation, and the classification of ore deposits.

No text-book is used. The outline of course is obtained from the syllabus. The leading treatises on the subject of ore deposits are constantly consulted. The aim of the course is to give a concise and philosophical view of the foundation of ore exploitation, and modern mining. A number of specific cases out of the total number met with by the student in the course of his inspections are critically tested by the several general theories of ore deposition.

Prerequisites: Courses 1, 2, 3, 4 and 5 of this department must precede, Courses 1 and 2 of Department VIII must precede or accompany.

Time: Class-room, four hours a week, first half of first semester.

Field, three hours a week, first half of first semester.

(b) Types of Ore Deposits.

In accordance with the scheme of classification adopted the main types of ore deposits are discussed in all their aspects, and illustrations of each given. The subject is approached from the geological view-point. The general plan followed is essentially an arrangement of the geological processes, so far as they affect specifically the ore bodies and their original deposition. The resulting ore classification itself is in terms of the forms of ore-bodies as geological formations or terranes, and as dependent upon geological

structures. This basis appears to be the only one that is truly genetic in nature, and yet serviceable in ore exploration.

The data for an ore classification of this kind are derived largely from the facts and principles established in the course of the great advancements recently made in the study of crystalline schists and metamorphic rocks in general, as the result of the applications of the microscope.

It is therefore quite essential that something of the principles and methods of microscopical petrography should have been acquired before the subject can be fully appreciated.

The fundamental thought running through the entire course is that the main thing to be sought for in the classification of the ore bodies is a system that is based upon genesis so far as possible, that is practical in application and that will aid in their discovery and development. It is assumed that each a scheme should be made so that the ordinary miner may use it. At the same time, it should not offend the most rigid theorist. This common ground seems to be found by given due consideration to certain geological principles which have recently been found to have a special bearing upon the deposition of ores themselves.

Comparisons are made between the principal classificatory schemes, including those of Von Oppel, Werner, Von Cotta, Whitney, Phillips, Von Groeddeck, Posepny and others.

During the various excursions to settled mines opportunity is given students to examine the ore bodies and to discuss and determine, each for himself, the method of formation and the type to which each ore-body belongs. This being accomplished, the best method of exploitation and the probable extent are considered. The secondary changes which the original ore-body has undergone are also studied.

Prerequisites: Same as for 14 (a) of this department.

Time: Class-room, four hours a week, second half of first semester.
Field, three hours a week, second half of first semester.

Text: Keyes, *Origin and Classification of Ore Deposits.*

15. Special Problems.

It is expected that the student has already become more or

less familiar with the various districts in the neighborhood of the School. He is encouraged to take up the exhaustive study of some limited area, in conjunction with, or under the guidance of his instructor, or he is given some area or theme that has already been well worked out and the results published, and he is required to repeat the investigation on his own account.

In the first case, the student usually takes up the work in connection with the regularly organized Geological Survey. He conducts his investigation as a part of the general inquiry of that institution. There is a wide range of topics from which to select. Nearly all departments of geology offer problems that are both varied and highly instructive.

In connection with the systematic geological work of the New Mexican region the broader problems are continually growing upon the student and some of these become available for extended and exhaustive original inquiry.

Prerequisites: Courses 1, 2, 3, 4 and 5 of this department, and Course 1 of Department VI.

Time: Field or laboratory, twelve hours a week, second semester.

16. Methods of Geological Correlation.

The modern conceptions of geological formations or terranes and the means of recognizing them in regions more or less remotely separated geographically are reviewed in considerable detail. Illustrations are drawn from nearby sources whenever possible. Comparative values of the different correlation methods are considered under diverse conditions. Adoption of different and perfectly independent methods in general correlative work is urged. Any given method may have quite different values in different localities. Marked discrepancies when one method alone is applied may be checked by the readings of other records.

Concrete examples are cited in which the various methods of correlative criteria have been applied and their practical values in field work determined. Correlation by means of similarity of lithologic sequence, by lithologic similarity, by faunal comparison, by orotaxis and by homogeny come in for special mention and discussion.

17. History of Opinion on Ore Deposition.

Near the close of the fourth year a short series of lectures is given in which the various views that have been held in regard to the formation of ore-bodies are set forth in detail, and compared. Their influence upon mining und upon scientific thought is dwelt upon at some length. These lectures are given weekly for eight weeks.

18. Principles of Ore Deposition.

During the last term of the fourth year the preceding course is followed by a number of weekly lectures on the general principles governing the formation of ore-bodies. Each lecture is given by a specialist who has given particular attention to some particular phase of the subject. The results of his investigation are set forth according to his own manner of presenting the facts and illustrations.

19. Geological Philosophy.

The great unsolved problems with which geologists today are wrestling are reviewed and discussed in all their various phases. The rise and growth of the ideas, the names of the men associated, and the present trend of thought upon these subjects are considered. References are made to the best literature on the various aspects of the different topics. The present tendencies of geologic work are concisely summed up.

20. History of Geology.

A connected account is given of the origin and development of modern geological thought, and the influences which have contributed to the evolution of the present tenets of the science.

It is expected that the student will supplement the lectures in this course, largely biographical in treatment, by careful perusal of the literature bearing upon the subject. The main aim of the course is to acquaint the student with the men who made of earth-study a science, with their personalities, their environments, the conditions under which they worked and the difficulties which they encountered.

21. **Research Work.**

It is a recognized tenet of the institution that the greatest benefits are not secured to the student until his training has been such as to enable him to conduct independent investigation. During the period of preparation previous to the time when independent inquiry is taken up with profit many problems will have suggested themselves for solution. If, however, the student has been unable to make any selection of topic for himself a suitable problem will be assigned to him.

The opportunities and facilities for research work in nearly all branches of geology are practically so unlimited and the entire field is such a virgin one that it is doubtful whether any other region in the whole country is so inviting as that of New Mexico.

For the study of mountain structure no region surpasses southwestern United States. The effects of vast erosion, the dry climate, the prodigious faulting and tilting of orographic blocks, all contribute to expose the stratigraphy and structure on a scale not to be comprehended elsewhere on the continent.

Many of the broader philosophical questions which now hold the attention of geologists the world over find ample illustration in New Mexico. Mountain building, epeirogenic movements, isostatic adjustment, vulcanism, land-sculpture and extensive sedimentation far removed from the sea, find innumerable phases awaiting careful study.

Mineralogy, petrography, ore-genesis and paleontology also offer new fields for profitable research.

22. **Thesis.**

Those students electing the general course in Mining Geology are expected to defend creditably the conclusions drawn from some more or less extended investigation. The theme may be in the nature of an extension of work already begun in the previous years, a special phase suggested during the preliminary researches, or on some entirely new subject, selected by the candidate for a degree, or by his instructor. Besides being distinctly a contribution to knowledge, the

thesis must show ample evidence of a wide acquaintance with the literature directly bearing upon the theme.

It is expected that the student during the last year of his course will devote at least one-third of his time to the preparation of his thesis. The subject of the thesis must be announced at least one year prior to the time when the student intends to come up for his degree, and be approved by the instructor under whose supervision the work is undertaken. If accepted, the thesis is required to be printed in standard form, or, if in part, to the extent of at least 20 pages, and 150 copies presented to the School.

VIII. DEPARTMENT OF MINING ENGINEERING.

ROBERT BRUCE BRINSMADE, PROFESSOR.

The instruction in mining is given by means of lectures illustrated by photographs and detailed drawings, and by field examinations. The latter enter largely into the more practical part of the work. Mine administration and mining law receive complete treatment. The entire course is pre-eminently practical in character, and articulates closely with both the courses in mining engineering and mining geology.

As one of the chief purposes of the School is to prepare men to be planners of mines and supervisors of mining operations, the strictly business character of the profession is kept constantly before the student. Valuing property, properly reporting propositions for investment, or as something to be let alone, calculating in a careful manner all the factors in the economical operation of a plant, suggesting the best methods of developing a property, are considerations which require many trials before perfectly satisfactory results are secured. This effort is given prominence.

Another important feature which is continually being more and more considered in mining operations is the geology of of the mineral deposits, and this subject receives greater attention than usual.

1. Mining Methods, A.

The following subjects are studied:

Mineral deposits, their classification from a mining standpoint and their irregularities as affecting the work of exploration and mining.

Examination of mineral properties; relation of topography to geological structure; tracing of probable outcrops.

Prospecting by ditches, pits and deep borings.

Development: choice of methods; location of openings.

Excavation of earth: tools; methods; supports.

Excavation of rock: explosives, kinds, nature, manufacture

and use; methods of drilling and blasting, mammoth blasts, submarine blasting; quarrying.

Tunnelling: methods of driving and timbering; submarine tunnels; permanent linings; sizes, speeds of advance and costs.

Boring: methods and appliances for small depths and for deep boring; the diamond drill; survey of bore holes.

Shaft-sinking: methods and tools for both hard and soft material; sinking linings; handling and hoisting of material; timbering, walling and tubing.

Surface workings and hydraulic mining.

Prerequisite: Courses 5, 6 and 7 of Department I, Courses 1, 2, 6 and 7 of Department II and Courses 1 and 2 of Department III.

Time: Class-room, five hours a week, first semester.

Texts: Foster, *Ore and Stone Mining.*
Ihlsing, *Manual of Mining.*

2. Mining Methods, B.

The subjects studied are:

Surface-handling and transportation; arrangements for loading, unloading and storage of minerals; mineral railroads and common roads.

Water supply.

Drainage: sources, control and raising of mine waters; dams; drainage-levels.

Ventilation: requirements for pure air; vitiation and purification of mine-air; methods of ventilation; measurement and control of air-currents.

Illumination: candles; torches; lamps classified as oil, gasoline, magnesium, acetylene, electric and safety.

Accidents to men from fire-damp, dust explosions, mine-fires, falling material and inundations; prevention; rescue and relief.

Prerequisites: Same as for preceding course.

Time: Class-room, three hours a week, second semester.

Texts: Same as in Course 1.

3. Examination of Mining Methods.

By inspection of mining methods followed in the various camps in the neighborhood of the School there is afforded great variety of illustration of the themes developed in the lectures.

The inspections are carried on partly as class-work in company with the instructor in charge, and partly as individual work. Full notes are required to be taken and these are subsequently reduced in the office to proper form, accompanied by the necessary sketches and plans to make the whole procedure thoroughly intelligible.

Prerequisites: Courses 1 and 2 of this department.

Time: Field, five hours a week, one semester.

4. Examination of Mines.

The main object sought in this course is to train the student sufficiently in expert mine examination work to enable him to report intelligently upon a mining proposition as to the advisability of purchase, or of operation.

Practice is afforded in making regular reports, complete in every respect, on different kinds of mining properties. Each student is assigned a different mine or property to examine. In case the mine has been reported upon in previous years detailed comparison of the results is afterwards made.

Among the more important topics usually considered are the topography of the district, as an index to its accessibility, and outside constructions, the character of the geological formations, the geological structure particularly as affecting the ore bodies, the character and disposition of the ores, the amount of ore in sight, the probable extent of the unexplored part, the best method of extracting the ore, of concentrating it, of preparing it for shipment or treating it immediately for the metal, the water facilities and the facilities for transportation to market. Full computations are required, and estimates of the cost of each process, and of the necessary plant, and each of the various parts.

Prerequisites: Courses 1 and 2 of this department and Course 3 of department VII.

Time: Field, ten hours a week, first semester.

5. Ore Dressing.

An advance course, the elements having been taken in General Metallurgy. Sizing with screens and with hydraulic classifiers. Concentrating with jigs, buddles, tables and vanners. Magnetic concentration.

Time: Class-room, three hours a week, second semester.

Text: Richards, *Ore Dressing and Concentration.*

6. Mine Plant.

The following machinery and appliances are studied and critically discussed.

Hoisting: engines, drums, wire rope, skips and cages, head-frames; calculation of power required and methods of equalizing the load on the engine; devices for prevention of over-winding; shaft-sinking plant.

Drainage: buckets, tanks and head-pumps; Cornish and direct-acting underground pumps: operation of pumps by electricity, compressed air and hydraulic power.

Ventilation: natural ventilation, underground furnaces, positive blowers and centrifugal fans; efficiencies of fans.

Air-compressors: straight-line and duplex; simple and compound compression; heat of compression; conveyance of compressed air; efficiencies.

Machine drills: construction and operation.

Underground haulage: mine cars; arrangement of tracks; hand tramming; mule and rope haulage; gravity roads; steam, compressed air and electric locomotives; comparative efficiencies.

Prerequisites: Courses 3 and 4 of this department.

Time: Class-room, three hours a week, one year.

7. Mine-Plant Design.

As in the designing of a metallurgical plant the student takes up a given mine, of which he makes all the proper surveys, plans the top-works, making full working drawings of all buildings, trams, ore-bins and similar constructions, draws up detailed specifications, bills of materials and full estimates of cost.

If an operating mine happens to be selected for this the entire work is gone over and improvement incorporated, and

suggestions made where savings may be made. This work, when further elaborated, will be accepted as a thesis.

Time: Laboratory, six hours a week, one year.

8. Mine Administration and Accounts.

In all the transactions of the mining courses particular stress is laid on the business aspects of mining operations. The value of keeping tabulated records of different grades of work, and its cost from day to day, is urged as a means of constantly reducing the fixed charges and of doing away with much of the extraordinary expenditures, without reducing the efficiency of the work. The devising of methods of increasing the output, with limited working forces is emphasized.

Not only are the subjects of labor in all its various phases, the details of supplies, and the sale of ore prepared for market taken up, but mine accounts, statements of cost and monthly reports are discussed.

Time: Class-room, two hours a week, first semester.

9. Mining Law.

A short course of lectures on mining law, particularly in relation to the manner of locating placer, lode and tunnel claims, on water rights, law of the apex and similar questions.

Time: Class-rooms, one hour a week for eight weeks, first semester.

IX. DEPARTMENT OF METALLURGICAL ENGINEERING.

ROBERT BRUCE BRINSMADE, PROFESSOR.

The Metallurgical Department aims to turn out its graduates equipped with the knowledge necessary to the successful management of metallurgical plants, and to take full charge of metallurgical operations. The graduate from this department has acquired a good working knowledge of assaying, chemistry, mill-work and smelting processes.

The courses have been chosen with special reference to giving to the student in metallurgical engineering a general knowledge of modern metallurgy as a whole, and special knowledge of the metallurgy of each of the more important metals. This special knowledge is attained by lectures, readings, discussions, laboratory work and inspection of metallurgical plants.

1. Fire Assaying.

The instruction in assaying is given by means of lectures and laboratory experimentation, the practice in the laboratory illustrating the lecture-courses. The laboratory is well equipped with several different types of assay-furnaces for crucible work, scorification and cupellation, and with everything that goes to make up a well furnished assay office.

This course comprises fusion methods for gold, silver and lead; the crucible assay of oxidized ores for gold and silver in the muffle and in the pot-furnace; crucible assay of sulphide ores for gold and silver by the iron, roasting, and preliminary fusion methods; also the crucible assay of lead ores. The scorification-assay of mattes and speisses, with preliminary wet treatment; assay of litharge and lead. In the assay of base-bullion, silver-bullion and gold-bullion, the methods in use in the United States mints are followed. Sampling and the preparation of the sample for assay; making cupels.

Numerous samples are provided, all of which have been

previously accurately assayed at the College, at the smelter from whence they came, or at the mint. The student works upon these until he attains a high degree of proficiency. No student is allowed to pass this subject until he has become an experienced assayer.

Prerequisites: Courses 1, 2, 3, 4 and 5 of Department III.

Time: Class-room, one hour a week, second semester.
Laboratory, eight hours a week, second semester.

Texts: Furman, *Manual of Practical Assaying.*
Rickett and Miller, *Notes on Assaying.*

2. Blowpipe Assaying.

The assay of ores for gold and silver by means of the blowpipe designed for special use in prospecting. This assay is for use in the field, and is made with a small, simple and readily portable outfit, The pulp-balance is one that can readily be any one out of a few p,eces of wood, two pieces of glass-rod and three needles. The fluxes are measured; and the resulting buttons are measured on a button-scale and calculated into ounces per ton. Notwithstanding its apparent crudity, very good results are obtained by this method, which is of the greatest value to prospectors.

Prerequisites; Courses 1, 2 and 3 of Department III.

Time: Laboratory, three hours a week one semester.

3. General Metallurgy.

A general view of the principles and modern processes followed in the extractions of metals from their ores. Fuel. Refractory materials. The metallurgy of lead, copper, gold, silver, platinum, mercury, antimony, and all other metals of industrial importance.

Each metal is discussed in the following manner: The metal and its properties, impurities and their effects, compounds and their properties, ores, principles of extraction, and process of extraction. The course confines itself to principles and general descriptions of methods. Details of manipulation and management may be acquired later in special courses on the metallurgy of lead, copper, iron, gold and silver, to which this course is a prerequisite.

Prerequisites: Course 1 of Department II, Courses 1 and 2 of Department III.
Time: Class-room, three hours a week, first semester.
Text: Rhead, *Introduction to Metallurgy.*

4. Metallurgy of Lead.

An advanced cause in lead metallurgy; occurrence of lead; the lead reverberatory furnace; Corinthian, Silesian and English methods of treating lead ores in the reverberatory furnace; Scotch, American and Moffet type of ore hearths; smelting lead ores in the ore hearth; roasting furnaces for lead ores; roasting galena as a preliminary to blast furnace treatment; the lead blast furnace; calculation of blast furnace charges; details of running a lead blast furnace; desilverization of base bullion.

Prerequisite: Course 3 of this department.
Time: Class-room, two hours a week, second semester.
Text: Hoffman, *Metallurgy of Lead.*

5. Metallurgy of Copper.

Occurrence of copper; roasting copper ores in heaps, stalls and roasting-furnaces; blast-furnace smelting; pyritic smelting; reverberatory smelting; bessemerizing copper mattes; electrolytic refining of copper; selection of process and management of plant.

Prerequisite: Course 3 of this department.
Time: Class-room, two hours a week, first semester.
Text: Peter, *Modern Copper Smelting.*

6. Metallurgy of Gold and Silver.

Occurrence of gold and silver; placer mining; the patio process; crushing and amalgamating machinery; pan amalmagation; chlorination by the vat and barrel processes; cyaniding by the MacArthur-Forrest, and Siemens-Halske processes; lixiviation of silver ores; pyritic smelting; refining and parting of gold bullion.

Prerequisite: Course 3 of this department.
Time: Class-room, two hours a week, second semester.
Texts: Rose, *Gold.*
Eissler, *Metalluryg of Silver.*

7. Metallurgy of Iron.

Modern methods of the production of pig-iron, wrought-iron and steel; the iron blast-furnaces; white cast-iron, gray cast-iron and spiegel-iron; puddling; wrought-iron; the Bessemer and Siemens-Martin processes; steel.

Prerequisite: Course 3 of this department.

Time; Class-room, two hours a week, first semester.

Text: Howe, *Metallurgy of Steel.*

8. Metallurgical Inspection.

Visits of inspection to mills and reduction works. While these visits are required during the third year only, at which time the student is capable of understanding all he sees and thus deriving the maximum amount of benefit from it, students not so far advanced are advised to take these trips whenever it does not seriously conflict with other studies.

A visit may be extended by special permission and the mill or reduction works used to furnish the material for a thesis.

9. Metallurgical Design.

Some time during the latter part of the general course in metallurgical engineering the student devotes a part of his time to detailed and original plans for a plant for ore treatment. From year to year the conditions vary so that no two persons have the same work. The designs are based upon the surveys made by the student upon sites especially selected for peculiar conditions presented. The working plans, for the buildings, concentraters, furnaces, etc., are drawn up complete in every respect, the full bill of materials made out and the cost of the several parts and of the whole carefully estimated according to the trade conditions and labor factors existing at the time. In fine, the entire work and all computations are carried out according to the best engineering practice, and with the same care that actual construction operations require.

Time; Six hours a week, one year.

10. Thesis.

Each student before receiving his degree of Metallurgical

Engineer is required to prepare and to present to the Faculty aa important scientific treatise upon a metallurgical subject. This treatise must be based upon work carried out by the writer while a student at the College. It must contain a complete record of all work performed by the writer upon the subject treated, the conclusions drawn from the work, and a statement of the lines along which, in the writer's opinion, it would be advisable to pursue the investigation further. These are bound and placed in the College library. Those which appear to be of especial interest or importance are published.

BUILDINGS AND GROUNDS.

The Campus.

The School of Mines campus is situated on the northwest edge of Socorro. It contains 20 acres of nearly level ground within the irrigable belt. Groves of trees have been planted; and trees line the walks and drives.

Main Building.

The main building consists of three stories and a high basement. It is T-shaped, 135 feet long by 100 feet, the central rear wing being 54x32 feet. It is constructed in a very substantial manner of a beautiful gray granite, in broken ashler, trimmed with Arizona red sandstone. It is well ventilated, and has all modern conveniences, being piped for water, lighted by gas, and heated by a good hot-water system. Throughout the building is handsomely finished in oiled hard woods.

As now arranged, the main floor of this building contains the president's office, the general library, the chemical laboratory, instructor's office, assay laboratory, balance rooms and lecture room. The basement story contains the mineralogical museum, lecture room, chemical supply room, boiler room, engine room, lavatories and general storage rooms. A lecture room occupies most of the second story. The third story includes a lecture room, supply room, photographic dark-room and storage closets.

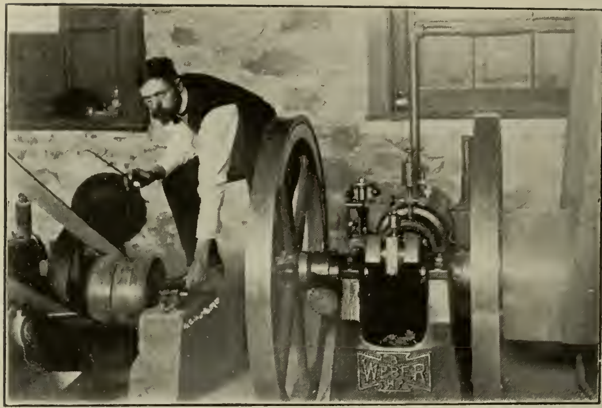
Engineering Hall.

The south wing of this building has already been erected. It is built of Socorro cream brick with gray trachyte trimmings.

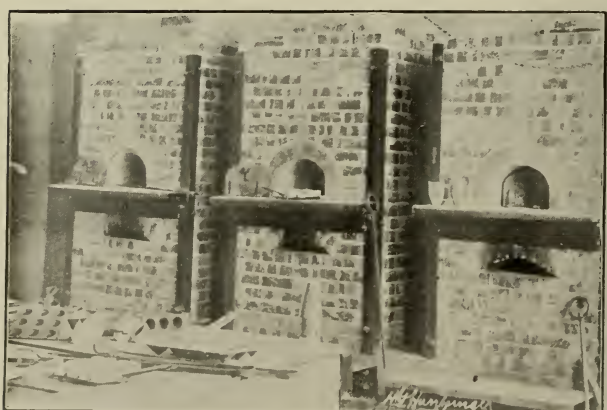
The building is X-shaped, as planned for completion after designs by E. B. Cristy, achitect of Albuquerque. The central pavilion is two stories, while the four wings are one story. It is peculiarly to adapted to the convenience of en-

gineering instruction. The features of the whole design are the spacious rooms.

When the building is completed the entire north wing will be devoted to draughting purposes, the light coming from above. At present the main draughting-room is in the south wing which also is a lecture room. Off of this are the instructor's office, and a blue-print room. A photograhic room is fitted up in the main building.



GRINDING ROOM IN ASSAY LABORATORY.



CORNER OF ASSAY LABORATORY—MUFFLE FURNACES.

EQUIPMENT.

Chemical Laboratory.

Very complete in its equipment, it is believed that the chemical laboratory of the New Mexico School of Mines ranks among the best in the country.

Besides being supplied with a balance-room, evaporation hoods and special tables, the laboratory is equipped with desks, six by two and one-half feet and thirty-eight inches high. Each desk has a cupboard on one side and a tier of five drawers on the other, all under Yale locks. There are water and gas connections, sink, and shelves for reagents with each desk. Every student in chemistry is supplid with a complete set of reagents and all apparatus for the work to be undertaken. Kipp's generators have been provided for, while the balance-room is supplied with quantitative balances of Becker's finest construction.

The chemical lecture-room has ample seating capacity. It is provided with standard lecture-room chairs, especially adapted to student's convenience in taking notes. The lecture-table extends entirely across one end of the room, and is fitted with water and gas connections, and large sink.

Assay Laboratory.

The assay laboratory occupies the main floor and basement of the west wing of the main building. The furnaces are all new and include muffle gasoline blow-pipe furnaces of different types, and large muffle coke-furnaces. This department is conveniently arranged with shelving, drawers and boxing for fluxes and other assaying materials and supplies.

A weighing-room, containing a number of Becker's balances, is conveniently located between the furnace-room and the lecture-room. In the grinding-room, which is in the basement, is an 8-horse-power gasoline engine of Weber type, which runs the Dodge ore crusher, a Bolthoff sample-grinder, and will supply power through a line of shafting to other

machines. There are also a Bosworth laboratory crusher, bucking-board, mullers and other necessary apparatus.

Petrographical Laboratory.

For the microscopic study of rocks, both in elementary and advanced or graduate work, the School is well supplied with microscopes and other necessary apparatus. There has recently added to the equipment a new style large microscope, manufactured especially for this institution by Reichert, of Vienna. It is constructed especially for obtaining fine results in microphotographic work. The stand includes a Continental Model substage with rack and pinion, an Abbe substage condenser, with iris diaphragm, plane and concave universal mirror, triple nose-piece, and a full set of objectives and eye-pieces. Among the accessories are a micrometer eye-piece, compensating eye-piece, polarizing apparatus, stage micrometer, drawing apparatus, quartz-wedge, quarter-undulating mica plate, and other necessary pieces.

A rock-slicing machine with power attachments enables the student to prepare thin sections of the rocks which he is studying.

Among the series of thin-slices of rocks are a collection of types of the massive crystallines of Europe, prepared by Krantz of Bonn, and completely illustrating Zirkel, sets of Maryland massives, and other American rocks and minerals. The Sturtz collection of European rocks illustrating Rosenbusch and large miscellaneous collections are expected to be soon available for study.

A rapidly growing collection of typical igneous rocks and crystalline schists of New Mexico, will afford material for thin-slice, obtained chiefly in connection with systematic investigations that are now being carried on.

Engineering Department.

For land, railroad and mine surveying the department has full sets of instruments, including transits, levels, poles, leveling rods, chains, pins, steel-tapes, hand-levels, compasses and clinometers.

The department has lately added to its equipment a fine large engineer's transit and all accessories, manufactured

expressly for this institution, after improved designs by the Gurleys of Troy. There is included an extension tripod, auxilary telescope, reflector, gradienter attachment, diagonal prism and solar apparatus.

Draughting Rooms.

A spacious, well-lighted draughting room is provided in the engineering building. Opening off it are the instructor's office, supply-room, blue-print room with large printing frame on steel track, developing vat and drying rack.

Drawing tables are furnished each student. There are private spaces for his materials and instruments. Provision is also made for models and illustrative materials.

The photographic rooms are located in the main building.

Mineralogical Museum.

The School owns a very fine collection of minerals of all kinds. These, properly labeled and arranged in glass cases, are housed in the north wing of the main building.

LIBRARIES.

The libraries of the New Mexico School of Mines consist of a general library and department libraries.

In the main library are the works of reference, the encyclopedias, dictionaries, journals, magazines, proceedings of the learned societies, laboratory publications, periodical issues of other colleges, reports of Federal, State and Foreign surveys, official maps, plats and atlases, and volumes on history, travel and philosophy.

Libraries are located in the several departments of the school. These are essentially working libraries. They consist of carefully chosen treatises, text-books, monographs, special contributions, and author's separates, pertaining to the respective divisions.

Powell Library. The school has recently come into possession of the private library of the late Major John W. Powell, of Washington, D. C., who for many years was director of the

United States Geological Survey. The collection embraces several thousand titles. The volumes are chiefly works on mining, geology and philosophy, many, of which are rare, and all are of great practical value. Especially well represented is the literature relating to the Rocky Mountain region and the great Southwest. It was in these fields that Major Powell did most of his work, which has had such an important influence on the development of the mining industry. It therefore seems particularly fitting that the library of this famous man, who had been so long identified with this western country, should find a permanent home in New Mexico.

MINERAL EXHIBIT AT ST. LOUIS.

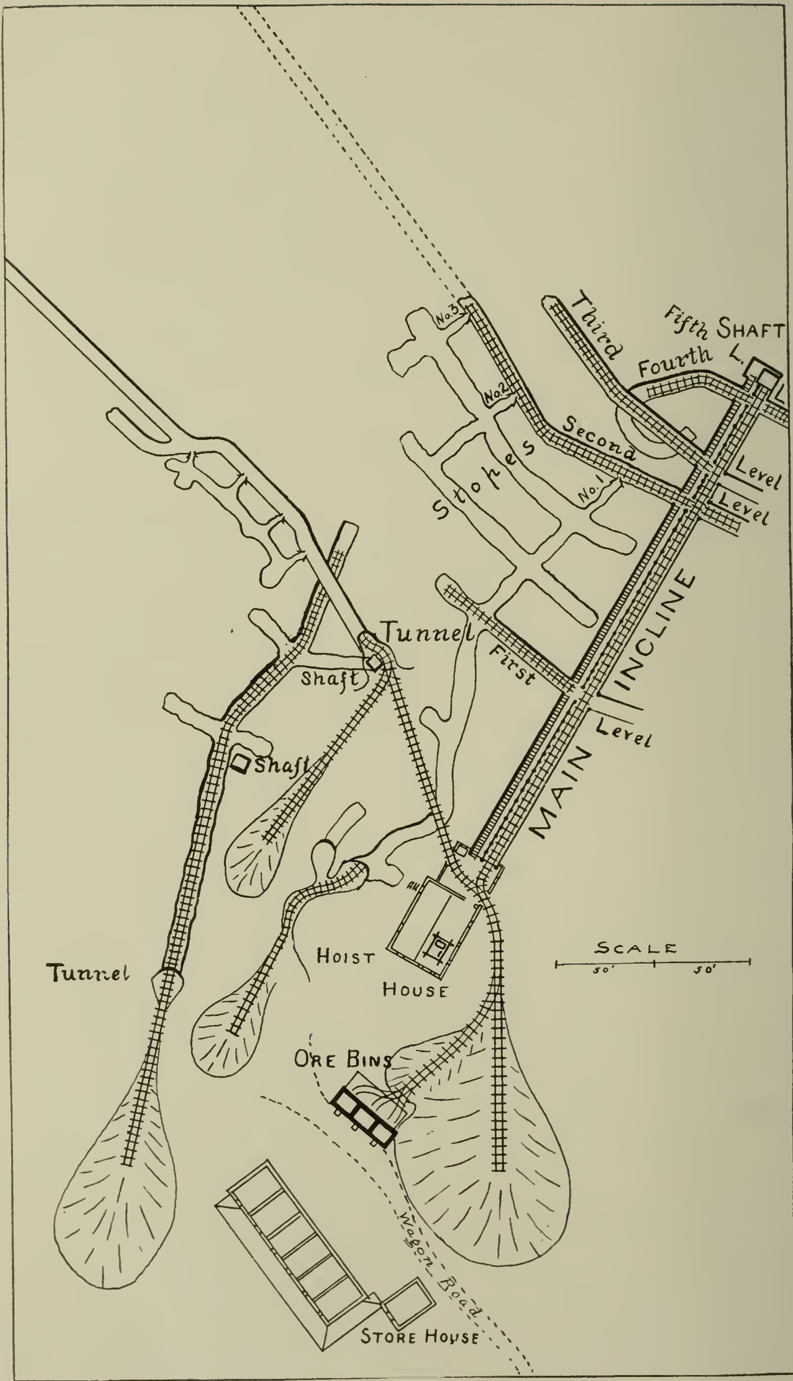
The major part of the New Mexico mineral exhibit at the Louisiana Purchase Exposition at St. Louis consisted of the collections prepared by the School of Mines. The display occupied a prominent place near the center of the Palace of Mines and Metallurgy. As the only exhibit of the kind made by a mining school it attracted wide attention.

The display was planned to center around a large colored relief model of New Mexico on a scale of half an inch to the mile—or nearly 20 feet square. On this model was shown all the mineral resources. It was accompanied by a large colored section of the geological formations.

Arranged in a score or more of large glass cases were the leading mineral products of New Mexico, selected with special care as to value and beauty. Included were a number of cases of remarkably rare and showy zinc and copper minerals and ores. A special series consisted of zinc carbonate minerals, which for variety, delicacy of coloration and beauty have never been surpassed. Two immense pyramids of showy crystalline ores were embraced in the display.

Four large special collections were of particular interest. These consisted of (1) the largest variety of zinc and copper minerals and ores from a single locality; (2) a collection of rare zinc and copper ores; (3) a unique collection of showy

EXHIBIT OF RARE ORES AND MINERALS AT ST. LOUIS.



PLAN OF THE TORRANCE MINE.

crystals of zinc and copper minerals; and (4) a complete smelting proposition from a single mine.

For these displays and several others, gold and silver medals were awarded.

All the collections have been returned to Socorro and now form a prominent feature in the museum of the School of mines.

THE TORRANCE MINE.

The School of Mines has already become the owner of the Torrance Gold and Silver Mine at the base of the Socorro Mountain, only about two miles from the School campus. This mine affords excellent opportunities for the practice of mine-surveying and for a study of all the various features of practical mining. Here are to be studied a double-compartment incline shaft, a fine example of mine timbering, various levels, cross-cuts, winzes, shafts, stopes, ore-bodies with associated geological structures and many other features of interest to the student of mining engineering.

INSPECTION VISITS.

Students in the mining and metallurgical courses are expected to make a two weeks tour of inspection of the mines. concentrators and smelters lying within easy reach of Socorro under the direction of the professor of mining and metallurgy. This tour may be made either during the Christmas vacation or at the close of the school year. Special stress is laid upon the proper keeping of notes. These are fully written up each day and are made use of later as a basis of other work in connection with the regular courses. If carefully kept they prove valuable references in later years.

At the close of the school year 1905-6 inspection visits were made to the mines, concentrators and smelters at El Paso, Douglas, Bisbee, Fairbanks, Tombstone, Naco, Cananea and Nacosari.

EXAMINATIONS.

Matriculation examinations are held at the close of the year in June, for the next year, and at the beginning of the year in September.

Regular examinations, which all persons under instruction in the School are required to attend, are held at the end of each month, for the purpose of determining the progress of the students.

At the close of each semester are examinations covering the term's work in each subject.

Candidates for advanced standing may be examined, if deemed necessary by the Faculty, in all studies, or any part of them, of their course preceding those of the class in which they wish to enter.

TUITION AND LABORATORY FEES.

Tuition Fees.

The fee for tuition is fifty dollars a semester. To *bona fide* citizens of New Mexico, the tuition is ten dollars a semester. The tuition fee is payable in semi-annual installments at the beginning of each semester. All laboratory fees are payable at time of registration.

There is a matriculation fee of five dollars (paid only once), There is no extra fee in any department of study, or for lectures.

Absence from School, or partial time devoted to the work of the School does not admit of any deduction of fees.

Laboratory Fees.

The laboratory fees are intended to cover the cost of materials, and also the depreciation due to use, in the value of the apparatus.

In chemistry, the laboratory fees are as follows:

General Chemistry, $5.00; Qualitative Analysis, $10.00; Quantitative Analysis, $10.00.

In fire assaying the laboratory fee is $10.00.

In the laboratories, other than the chemical and metallurgical, the fees are from three to five dollars.

Graduation Fee.

The graduation fee, payable before delivery of diploma, is as follows:

Mining, Metallurgical, or Civil Engineer............	$10.00
Bachelor of Science..............................	5.00

EXPENSES.

Rooms may be obtained at from $6.00 to $8.00 a month. Board, at boarding houses and in private families, is obtainable at from $18.00 to $23.00 a month. Plans are now being made for a students' cooperative boarding club in order to further reduce living expenses.

Three hundred dollars may be taken as a maximum for necessary expenses. Students may get along very well on $200.00 a year, if they are willing to economize.

SCHOLARSHIPS AND PRIZES.

Through the generosity of the members of the Board of Trustees and of others, the New Mexico School of Mines has has been able to establish a system of scholarships. These scholarships are awarded annually as honors, the main object being to encourage earnest effort on the part of those who wish to prosecute studies related to mining in this institution.

States Scholarships. Fifty scholarships, each yielding $100.00 annually, are open to students living in the United States. They are held for one year. These scholarships are assigned some time during the first semester of the school year.

There is one scholarship for each state in the Union. The student from each state passing the best examination for entrance to the school, or to advanced standing, or furnishing

evidence of best qualifications to carry on the work in this institution, is awarded the scholarship of that state. States scholarships are bestowed upon the following conditions:

1. The application must be made in writing before May 1 of the academic year preceding that in which the scholarships are awarded.

2. Accompanying the application should be a short statement of the candidate's previous training, and indication of the course he wishes to pursue.

3. Holders of scholarships are not exempt from laboratory fees.

In case in any one year worthy candidates do not offer themselves from any one state, the board, at its option, may reserve such appointments, or awarded them to applicants from other states, preference being given to students who already hold college degrees, or who present evidence of unusual attainments in mining studies.

New Mexican Scholarships. Forty scholarships, each yielding $25.00 a year, are open to students who are actually residents of New Mexico. They are good for one year and are bestowed at the beginning of each school year.

These scholarships are awarded to the two students from each county in New Mexico passing the best examination for entrance, or for advanced admission to the school, or presenting the evidences of best qualifications for carrying on the work of the course selected.

Examinations must be taken at the regular time at the end or at the beginning of the school year. As in the case of the States scholarships, the New Mexican scholarships are bestowed as honors, and as incentives to good work. Holders of scholarships are expected to proceed to a degree.

Allis-Chalmers Scholarship. To one member of each year's graduating class there is offered by the Allis-Chalmers Company, manufacturers of mining and heavy machinery, with large works at Chicago, Milwaukee and Scranton, an opportunity for four months study and employment in any of its plants, and an emolument of $150.00.

This scholarship is awarded by the Board of Trustees on the recommendation of the Faculty from those graduates of the year filing application before the 10th of June. The op-

portunity is an exceptional one to observe and study the building of all kinds of modern mining and metallurgical constructions.

Brown Medal. Hon. C. T. Brown, of Socorro, offers annually a gold medal to the student who while doing a full year's work has shown the greatest proficiency in the subject of assaying. The medal is publicly awarded at commencement in June of each year. Last year the medal was received by Mr. Samuel Cockerill, of North Fork, Virginia.

SUMMER WORK.

The proximity of the School to mineral properties, mines and smelters, makes it easy for the student to secure employment during the summer (and during the Christmas vacation if desired) and at the same time to acquire much practical experience in the line of his profession. That this advantage has been appreciated is shown by the large proportion of students who yearly make use of this opportunity. During the past years, land-surveying, mine-surveying, geological surveying, assaying and mining have been attractive fields of work for the students during the vacations.

DEGREES.

The degree of Bachelor of Science, Mining Engineer and Civil Engineer are conferred upon recommendation of the Faculty. No candidate for a degree may be recommended except after the required examination and a residence at the School of mines of at least one year.

The degree of Bachelor of Science is offered students who have followed the prescribed courses of college study for a period of not less than three years, the last one of which must have been passed in this Institution. Work done at other colleges may be accepted so far as it may correspond to the work done here, but in each case the Faculty reserves the

the right to decide whether this previous work has been satisfactory.

In announcing his intention of becoming a candidate for the degree of Bachelor of Science the student should bear in mind that the requirements are essentially those of colleges of good standing where the length of the period of study leading up to the bachelor's degree is four years. It is expected that the candidate for the bachelor's degree shall proceed to the engineer's degree.

The degree of Civil Engineer is offered upon terms similar to those required in the case of the mining engineer, except that the candidate substitutes in some of his later work courses which relate more directly to the profession he expects subsequently to follow.

The degree of Mining Engineer is offered to students who have taken the bachelor's degree at this School, upon pursuing satisfactorily, for a period of at least one year, studies in any one of the general courses in mining engineering, metallurgical engineering or mining geology.

A candidate for the engineer's degree who has not taken all of his college work in this institution, must present sufficient evidence to convince the Faculty that he has completed equivalent courses in colleges of good standing, he must be in residence in this School for a period of not less than one year, and he must pass the required examinations. In no case will private study, or study pursued away from libraries, laboratories and the other facilities usually offered by higher educational institutions, be considered equivalent to study pursued in the School of Mines.

In all cases in which any portion of a candidate's time has been passed elsewhere than at this institution, the Faculty shall decide whether the work done is satisfactory, and whether, in those instances in which work has been undertaken outside the School, any period may be considered as passed under favorable conditions and proper guidance.

Formal application to the Faculty must be made by the student desiring to be enrolled as a candidate for a degree. This declaration of his intentions must be made at least one year prior to the time when the student expects to present himself for his examination.

The applicant must fully satisfy several conditions before he is entitled to proceed to the engineer's degree. The entire year previous to his graduation must have been spent by the student at this school; he must have completed in a creditable matter the scheduled sequence of studies; he must have passed the final examinations; and he must have presented a dissertation on some phase of his work, that shall show some marked degree of originality and scholarly attainment, and that shall be acceptable to the faculty of the school. It is expected that the thesis in each case shall be prepared with sufficient care and exhibit sufficient intrinsic evidences of independent investigation to warrant its publication, in whole or in part.

Names of candidates who, in the opinion of the faculty, have fulfilled satisfactorily the various requirements of the school, are submitted to the Board of Trustees, and with its approval the degree is publicly conferred, at the regular time of year chosen for that purpose.

COMMERCIAL ANALYSES.

The wide demand which exists in the great mining district of the Southwest for disinterested and scientific tests and practical investigations has lead to the establishment, by the New Mexico School of Mines, of a bureau for conducting commercial work relating to mining and metallurgy.

The performance of such work is made possible, and accurate results assured, by reason of the exceptional facilities of the laboraties of the school and the extensive practical experience of the instructors. The rapidly increasing amount of this work intrusted to the school is sufficient evidence in itself that the plan has been long needed to further the development of the mineral resources of the region.

A special act of the Legislature makes provision for carrying on commercial testing. The section from the law governing the School of Mines, Chapter 138, Section 38, Acts of 1889, reads: "The Board of Trustees shall require such compensation for all assays, analyses, mill-tests or other services

performed by said institution as it may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines."

A special circular is issued, giving the schedule of charges, other necessary information and methods of preparing and shipping samples. Copies are mailed on application. By special resolution it is required that all charges shall be paid in advance.

Commercial Assaying. The assaying for gold, silver, copper lead, zinc and the common metals, is carried on in all its various phases. All work is run in duplicate and in case of any nonconcordant results such assay is repeated. Particular attention is paid to umpire work.

Determinations of silica, iron, alumina, magnesia and manganese and of the rarer metals such as uranium, vanadium, nickel and cobalt are made according to the best methods.

Water Analysis. The chemical analysis of waters for city-water supplies, boilers and domestic use and of mineral and mine-waters has of late assumed great importance. The chemical laboratory of the School is fully equipped for this work and in the case of bad waters remedies and methods to be used to improve the waters for specific purposes are suggested. A large number of analysis of waters from the Southwest have already been made, and very interesting results obtained.

Fuel Analysis. Another branch of work which has been constantly receiving more attention has been an inquiry into the fuel values of the coals of the region. Complete analyses and heat tests, have been made of some of the principal deposits. With the work already done the results of new analyses are made of special value on account of the comparative figures that can be supplied.

DIRECTORY OF GRADUATES AND FORMER STUDENTS.†

ARTHUR H. ABERNATHY. Cananea. Mexico.

Student 1898-1901. From Pinos, Zacatecas, Mexico. Assayer, Cananea Smelting Works, since 1901.

C. E. BARCLAY. Maria, Texas.

(A B. University of Virginia).

Student, 1896-7. From Bowling Green, Kentucky.

JAMES F. BERRY. Águas Calientes, Mexico.

Student, 1904-5. From Socorro, N. M. Assayer with American Smelting and Refining Co., at Aguas Calientes, since 1905.

LOUIS AUGUST BERTRAND. Mapimi, Durango, Mexico.

Student, 1905-6. From Conway, Iowa. Student Ecolé Professionelle de l'East, Nancy, Lorraine, 1890-95; Instructor in Mathematics and French, New Mexico School of Mines, 1895-6; Chemist, El Paso Smelting Works, El Paso, Texas; Assayer and Surveyor, Consolidated Kansas City Smelting and Refining Co., Chihuahua, Mexico; Superintendent Carmen Mines, Coahuila, Mexico; Superintendent Compania Mineros de Penales, Mapimi, Durango, Mexico, since 1901.

CHAUNCEY E. BUTLER. Dedrich, California.

Student, 1893-6. From Kelley, New Mexico. Assayer Cibolo Creek Mill and Mining Co., San Francisco, California, 1896; Assayer and Furnace Superintendent, El Compania Minera Lustre, Magistral, Estado de Durango, Mexico, 1897-8; Chemist and Assayer, United Verde Copper Co., Jerome, Arizona, 1898-1903; Superintendent Trinity County Gold Mining Co., and Jenny Lind and Maple Mining Co., Dedrich, California, since 1903.

R. HARLAND CASE. Zacatecas, Mexico.

Student, 1902-5. From Los Cerrillos, N. M. Chemist, Compania Metalurgica de Torreon, Torreon, Mexico, 1905-6; Assistant Superintendent, Bonanza Mine, Zacatecas, Mexico, 1906.

EDWARD C. CHAMNEY. Minnehaha, Arizona.

Student, 1899-1900. From Shipley, Ontario. Canada. Assistant in General Science, New Mexico School of Mines, 1900-01; Assayer, Oro Mining Co., Minnehaha, Arizona, since 1901.

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† Information concerning former students not here listed or concerning changes of address of those already listed will be gladly received.

VIVIAN V. CLARK. Albuquerque, New Mexico.

Student, 1896-8. From Kelley, New Mexico. Assayer Bland Milling Co., Bland, New Mexico, 1898-9; Superintendent, Navajo Gold Mining Co., Bland, New Mexico, 1900; Manager, Higueras Gold Mining Co., Sinaloa, Mexico, 1901; Mine Operator, Albuquerque, New Mexico, since 1902.

DAVID JOSHUE CLOYD. Aguas Calientes, Chihuahua, Mexico.

Student, 1899-1900. From Decatur, Illinois. Chemist in Wardman Assay Office, Aguas Calientes, Chihuahua, Mexico, since 1900.

SAMUEL COCKERILL. Chicago, Illinois.

(A. B., Valparaiso University.)

Student, 1904-6. From North Fork, Virginia. Holder of Allis-Chalmers Scholarship, 1906-7.

THEODORE STEWARD DELAY. Creston, Iowa.

(B. S. and M. E., Missouri School of Mines.)

Graduate Student, 1893-5. From Creston, Iowa. Assistant Professor of Chemistry, New Mexico School of Mines, 1894; Assayer, Tassel Mining and Milling Co., Alma, Colorado, 1895; Assistant Superintendent, I. X. L. Milling and Refining Co., Breckenridge, Colorado; Manager, Hoosier-Yukon Mining and Milling Co., Forty-Mile District, Alaska; Metallurgist, Creston-Colorado Mining Co., Creston, Iowa, since 1900.

LEON DOMINIAN. Zacatecas, Mexico.

(B. A. Roberts College Constantinople, 1898; C. I. M., Mining School, University of Liege, 1900.)

Graduate Student, 1903-4. From Constantinople, Turkey. Assistant, U. S. Geological Survey, 1903; Instructor in Mathematics, New Mexico School of Mines, 1903-4; Engineer to Victor Fuel and Iron Co., Denver, Colo., 1904-6; Superintendent, Bonanza Mine, Zacateca, Mexico, 1906.

ROBERT CASIANO EATON. Comanjo, Jalisco, Mexico.

Student, 1893-4. From Socorro, New Mexico. Sampling Mill Foreman, Compania Metalurgico Mexicana, San Luis, Potosi, Mexico, 1894-98; Superintendent, Muriedas Smelting Works, Xichu, State of Guanajuato, Mexico, 1898; Superintendent of Railroads, Compania.

ALEXANDER WALTER EDELEN. Elkton, Colorado.

Student, 1905-6. From Baltimore, Md. Assistant Superintendent, Elkton Consolidated M. and M. Co., 1906.

HARRY THORWALD GOODJOHN. Mapimi, Mexico.

Student, 1902-3. From Pittsburg, Texas. Assayer, Cia Metalurgica de Torreon, Torreon, State of Coahuila, Mexico, 1903-1906; Chief Chemist, Mapimi Smelter, 1906.

SAMUEL JAMES GORMLEY. West Jordan, Utah.

Student, 1895-6. From Mt. Vernon, Iowa. Assistant Professor of Engineering, New Mexico School of Mines, 1895-7; Assistant Assayer, Anaconda Copper Mining Co., Anaconda, Montana, 1897-1900; Chemist to same company, 1900-02; Superintendent of Sampling Works, Washoe Smelting Co., Anaconda, Montana, 1902-06; Smelter Superintendent, Bingham Copper and Gold Mining Co., West Jordan, Utah, since 1906.

ANTON HOGWALL. Nogal, New Mexico.

Student, 1898-99. From White Oaks, New Mexico. Assayer, Buckeye Mining Co., Water Canyon, New Mexico, 1900; Assayer, South Homestake Mining Co., and Helen Rae Ming. Co., White Oaks, New Mexico, 1901; Assayer, American Gold Mining Co., Nogal, New Mexico, since 1902.

CARL JOHN HOMME. Gulf Creek, N. S. W., Australia.

(A. B., St. Olaf College.)

Graduate student, 1899-1900. From Wittenburg, Wisconsin. Assayer and Chemist to Candelaria Mining Co., El Paso, Texas, 1900-01; Assistant Superintendent, Gulf Creek Mining Co., Gulf Creek, New South Wales, Australia, since 1902.

WILLIAM ELIAS HOMME. Gulf Creek, Australia.

(A. B., St., Olaf College.)

Graduate student, 1902-03, From Wittenburg, Wisconsin, Assayer. Gulf Creek Mining Co., Gulf Creek, New South Wales, Australia, 1902.

HAYNES A. HOWELL. Acapulco, Mexico.

Student, 1900-1905. From Socorro, N. M. Civil engineer on railway from Acapulco, Mexico, since 1906.

HARRY J. HUBBARD. Temosachic, Mexico.

Student, 1905-6. From Bisbee, Arizona. Mine-foreman, for Greene Gold-Silver Co., at La Navidad Mine, Temosachic, Mexico, since 1906.

ARCHIBALD J. HUNT. Mapimi, Mexico.

Student, 1903-5. From Providence, R. I. Assistant Chemist at Mapimi Smelter, since 1906.

JOHN AUGUST HUNTER. Aguas Calientes, Mexico.

(B. S., New Mexico School of Mines, 1903.)

Student, 1899-1903. From Socorro. Chemist, Consolidated Kansas City Smelting Co., El Paso, Texas, 1893-4; Chemist and Metallurgist, American Smelting and Refining Co., Aguas Calientes, Mexico, since 1904.

CHARLES THAYER LINCOLN. Iowa City, Iowa.

(S. B., Massachussetts Institute of Technology, 1901.)

Graduate student, 1902-3. From Boston, Massachusetts, Chemist to American Bell Telephone Co., Boston. Mass., 1901-2; Assistant in Analytical Chemistry, New Mexico School of Mines, 1902-3; Acting Professor, same, 1903-4; Instructor in Chemistry, Iowa State University, Iowa City, since 1904.

FRANCIS CHURCH LINCOLN. Patagonia, Arizona.

(S. B., Massachussetts Institute of Technology.)

E. M., New Mexico School of Mines, 1902. Assayer to San Bernardo Mining and Milling Co., 1900; Chemist to Butterfly Terrible Gold Mining Co., 1900-01; Professor of Chemistry and Metallurgy, New Mexico School of Mines, 1901-2; Professor of Metallurgy, 1902-04; Assistant Superitendent. Ruby Gold and Copper Co., Ortiz, State of Sonora, Mexico, 1904; General Manager Arizona Gold and Copper Co., Patagonia, Arizona, since 1904.

HARRY C. MAGOON. Chicago, Illinois.

Student, 1899-1900. From Chicago, Illinois. Engineer with Illinois Steel Company, since 1900.

CONRAD M. MEYER. New York, N. Y.

(A. B., New York University, M. D., Bellevue Hospital.)

Graduate student, 1900-01. From New York City. Mining Engineer, 136 5th Avenue, New York City, since 1901.

TARVER MONTGOMERY. Santa Ana, California.

Student, 1899-1901. From Santa Ana, California. County Surveyor, Orange County, California, 1900-01. Assistant Engineer, Temescal, Water Co., Corona, California, 1901; Transitman, San Pedro, Los Angeles, and Salt Lake Railroad Co., 1901-02; Assistant Engineer, Pacific Electric Railroad Co., Santa Ana, California, since 1902.

ERLE D. MORTON. Aurum, Nevada.

Student, 1903-5. From Los Angeles, Cal. Assistant Superintendent of the Giroux Consolidated Mines Co., of Kimberley, Nevada, since 1905.

WILLIAM FREDERICK MURRAY. Denver, Colorado.

Student, 1904-6. From Raton, New Mexico. In the General Mining Engineer's Office of the Victor Fuel Co., at Denver, since 1906.

PATRICK J. O'CARROLL.*

(B. A. University of Dublin, Ireland).

Graduate student, 1898-9. From Dublin, Ireland. Mine Operator, Gallup, New Mexico, 1899-1901.

* Deceased.

ALVIN OFFEN.*

Student, 1895-6. From Butte, Montana. E. M., 1896; Assistant Superintendent, Philadelphia Mine, Butte, Montana, 1896-7.

JUAN PALISSO. Mexico.

Student, 1903-4. From Barcelona, Spain. Mining Engineer, Mexico.

FOUNT RAY. Italy, Texas.

Student, 1991-2. From Waxahachie, Texas. General Manager, Lena Mining and Concentrating Co., Lordsburg, New Mexico, 1902; Cashier, Citizens National Bank, Italy, Texas, since 1902.

ALBERT BRONSON RICHMOND. Patagonia, Arizona.

Student, 1900-01. From Las Priestas, Sonora, Mexico. Superintendent, Ramona Mill Co., Gairlon, Sonora, Mexico, 1901-02; Assayer, Patagonia Sampling Works, Patagonia, Arizona, 1902: Assayer and Metallurgist, Patagonia, Arizona, since 1902.

DELL FRANK RIDDELL. Chicago, Illinois.

(Ph. G.. Chicago, College of Pharmacy, 1896: B. S., Nebraska State University, 1901).

Graduate student, 1903-5. From Sioux Falls, South Dakota. Professor of Chemistry. Sioux Falls College, 1901-3; Instructor in Chemistry, New Mexico School of Mines, 1903-4; Acting Professor of Assaying, same, 1904-5; M. E., same, 1905; Holder of Allis-Chalmers Scholarship, 1905-6.

WILLIAM CARLOS STEVENSON. Redlands, California.

Student, 1900-01. From Hillsboro, Ohio. General Manager, Mining Corporation, Albuquerque, New Mexico, since 1901.

JOHN STUPPE. Torreon, Coahuila, Mexico.

Student, 1903-4. From El Paso, Texas. Accounting Department, El Paso Smelting Works, El Paso, Texas, 1896-1902; Metallurgical Department, Compania Metalurgica de Torreon, Torreon, Coahuila, Mexico, since 1902.

LEO RICHARD AUGUST SUPPAN. St. Louis, Missouri.

Student. 1895-6. From St. Louis, Missouri. B. S. in Chemistry and Metallurgy, 1896; Instructor in Chemistry, New Mexico School of Mines, 1895-7; Graduate Student, Johns Hopkins University, 1897-8; Professor of Chemistry, Marine-Sims College of Medicine, St. Louis, since 1898.

CHARLES L. SEARCY. Monterey, Mexico.

Student, 1903-4. From Peoria, Illinois, Mining Engineer, Monterey, Mexico.

CHARLES H. SHAMEL. Taylorville, Illinois.

(B., S., M. S., Illinois State University; L. L. B., Michigan University).

Graduate student, 1901-2. From Taylorville, Illinois. Attorney at Law, Taylorville, Illinois, since 1902.

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* Deceased.

OLIVER RUSSELL SMITH. Socorro, New Mexico.

(B. S., Kansas College of Agriculture and Mechanic Arts, 1898.)

Graduate Student, 1899-1901. From Manhattan, Kansas. B. S., in Civil Engineering, New Mexico School of Mines, 1901; Assistant in Mathematics and Draughting, New Mexico School of Mines, 1900-01: Instructor in Engineering and Drawing, New Mexico School of Mines, 1901-2; C. E., New Mexico School of Mines, 1903; Assistant-Professor in Engineering and Drawing, New Mexico School of Mines, 1902; Assistant-Surveyor, U. S. Land Office, 1902; City Engineer of Socorro, New Mexico, 1902; Deputy Mineral Surveyor, U. S. Land Office, 1903; Professor of Civil Engineering, New Mexico School of Mines, since 1902.

OTTO JOSEPH TUSCHKA. Monterey, Mexico.

Student, 1893-7. From Socorro, New Mexico. E. M., in Metallurgy, 1897; Assayer and Chemist, Graphic Smelting Works, Magdalena, New Mexico, 1897-8; Graduate student, New Mexico School of Mines, 1898-99; Assistant Sampling-Mill Foreman and Chemist, Guggenheim Smelting and Refining Co., Monterey and Aguas Calientes, Mexico, 1899-1900; Assayer, Seamon Assay Laboratory, El Paso, Texas, 1900; Chemist, Compania Minera Fundidora y Afinadora "Monterey," Monterey, Mexico, since 1900.

MILTON BENHAM WESCOTT. El Paso, Texas.

Student, 1904-5. From Chicago, Illinois. Assistant County Surveyor of El Paso County, Texas, since 1905.

PATRICK ANDREW WICKHAM. Victor, Colorado.

Student, 1893-4. From Socorro, New Mexico. Assistant, Rio Grande Smelting Works, Socorro, New Mexico; Mechanical Engineer, Buckeye Mining Co., and Albemarle Mining Co., Bland, New Mexico, 1898-99; Mechanical Engineer, Mt. Beauty Mining Co., Cripple Creek, Colorado, 1899-1900; Engineer, Empire State Mining Co., Cripple Creek, Colorado, 1900-01; Engineer, Guggenheim Exploration Co. Minas Tecolotes, Santa Barbara, Mexico, 1901-02; Residence Engineer, Independence Consolidated Mining Co., Independence, Colorado, since 1902.

WAKELEY A. WILLIAMS. Grand Forks, British Columbia, Canada.

Student, 1893-4. From Council Bluffs, Iowa. Assistant Superintendent and Metallurgist, Granby Consolidated Mining, Smelting and Power Co., Grand Forks, since 1898.

ROLL OF STUDENTS.

(For the Fiscal Year Ending November 30, 1905.)

Antonio Abeytia (*A*)............................Socorro, N. M.
Juan Jose Baca, Jr. (*C*).......................... "
James Fielding Berry (*C*)...................... "
Wade Hampton Bliss (*C*)........ ....Sherman, Texas.
Cony C. Brown (*A*)..............................Socorro, N. M.
Harry Lawrence Brown (*C*)...................Chicago, Ill.
John Bruton (*A*)........................ ....San Marcial, N. M.
William B. Calvert (*C*) ....Richfield, Neb.
B. S. Nebraska State University.
George Franklin Card (*C*)......................St. Louis, Mo.
R. Harland Case (*C*).... ....Los Cerillos, N. M.
Samuel Cockerill (*C*)...............................North Fork, Va.
B. S. Valparaiso University.
Anthony Collinson (*C*)..........................Clarendon, Texas.
Luther Gross Crowley (*C*)......................Las Vegas, N. M.
Thomas Dennison Curry (*C*). . ...Chicago, Ill.
Claude Harold Daily (*A*).........................Socorro, N. M.
Frederick Dupont Davis (*C*)....................Brooks, Me.
William Reed Densmore (*C*)....................Painesville, Ohio.
Alexander Walter Edelen, Jr. (*C*)..............Baltimore, Md.
Thadeus Bell Everheart (*C*)....................Bells, Texas.
C. Edward Fitch (*A*).... ... .Socorro, N. M.
Helen G. Gordon (*A*)............................ "
Irene H. Gordon (*A*)............................ "
John Josish Gibbens (*C*)........................Perry, Okla.
Samuel Roland Ginsburg (*C*).............. ....New Haven, Conn.
Hezekiah Hall (*C*)................................Water Canyon, N. M.
W. L. Harrington (*C*)...........................Denver, Colo.
Isabel Harris (*A*)..................................Socorro, N. M.
Willis Hayes Hightower (*C*)....................Frisco, N. M.
James Monroe Hill (*A*)..........................Socorro, N. M.
Anna K. Hilton (*A*)......... ....Socorro, N. M.
Joseph Jacobson Hilton (*C*)....................Socorro, N. M.
Pierre Van Acker Hines (*C*).................. ..El Paso, Texas.
Rue Neil Hines (*C*)...............................Parral, Mexico.
Harry H. Hische (*C*)............... ....Deming, Colo.
Frederick Kilgore Howell (*A*)..................Socorro, N. M.
Haynes Alfred Howell (*C*)................. . "
Harry Jenkins Hubbard (*C*)....................Bisbee, Arizona.
William E. Hult (*C*)..............................Socorro, N. M.

Archibald John Hunt (*C*)........................ Providence, R. I.
Clyde Cleveland Hurst (*A*)..................... Socorro, N. M.
Pearl Kealer (*A*)................................ "
Bertha E. Kutzner (*A*).......................... "
Edith Dale Kutzner (*A*)......................... "
Harry Clay Kibe (*C*)........................... Jarilla, N. M.
Robert Ingersoll Kirchman (*C*).................Socorro, N. M.
Albert Henry Laufensweiler (*C*)...............San Antonio, N. M.
Montrose L. Lee (*C*)..............................Omaha, Neb.
Ellis McDougall (*C*)..............................Albuquerque, N. M.
D. D. S., Baltimore Dental College.
Thomas Benjamin McCauley (*C*)................Deming, N. M.
Morton Kemper McMillan (*C*)...................Socorro, N. M.
Charles Gainewell Montgomery (*C*)..............Pineville, Ky.
Erle D. Morton (*C*)...............................Prescott, Arizona.
William Frederick Murray (*C*)..................Raton, N. M.
James Dynan Newton (*C*)........................Tularosa, N. M.
A. B. and A. M., Holy Cross College; Mec. E., Cornell University,
Harry Lewis Peck (*C*)............................Elyria, Ohio.
John George Repplier (*C*).......................Reading, Pa.
Dell Frank Riddell (*C*)..........................
B. S., Nebraska State University; Ph. C., Chicago College Pharmacy.
Louis Marquette Richards (*C*)..................Rolla, Mo.
Orlando Douglas Robbins (*C*)..................Louisville, Ky.
Marcus Antonius Sayler (*C*)....................
B. S., South Dakota Agriculture College M. D., Minnesota State University.
M. Sėdivy (*C*)......................................Cleveland, Ohio.
James Avery Smith (*A*)..........................Socorro, N. M.
Marvel Morton Smith (*C*)........................ "
Clarence Scott Southworth (*C*).................Los Angeles, Cal.
Frank Sperling (*A*)...............................Belen, N. M.
Edwin Donald Swisher (*A*)......................Magdalena, N. M.
Milton Benham Wescott (*C*).....................El Paso, Texas.

INDEX.

NEW MEXICO SCHOOL OF MINES

MAIN BUILDING.

ANNUAL REGISTER

OF THE

NEW MEXICO SCHOOL OF MINES

SOCORRO, N. M.

1906-7

WITH ANNOUNCEMENTS FOR 1907-8

SANTA FE, N. M.:
THE NEW MEXICAN PRINTING COMPANY
1907

CALENDAR.

1907–1908.

First Semester:

September 9, Monday—Registration of students.
September 10, Tuesday—Recitations begin.
November 28, Thursday—Thanksgiving recess.
December 20, Friday—Christmas vacation begins.
January 6, Monday—Work resumed.
January 20, Monday—Examinations begin.

Second Semester:

January 24, Friday—Registration of students.
January 27, Monday—Recitations begin.
February 22, Saturday—Washington's birthday.
May 25, Monday—Examinations begin.
May 27, Wednesday—Commencement.

FACULTY.

ROBERT PEELLE NOBLE, Ph. B., A. M. *President of the Faculty, Professor of Chemistry.*

Ph. B , DePauw University, 1891: Assistant in Chemistry, DePauw University 1889; Graduate student, Johns Hopkins University, 1892; A. M. DePauw University, 1894: Principal Crawfordsville High School, 1894-1897; Graduate student, University of Chicago, 1897-1898, 1900-1901 and 1903-1904; Professor of Chemistry, Vincennes University, 1898-1900; Assistant Professor of Chemistry, Armour Institute of Technology 1901-1904; Professor of Chemistry, New Mexico School of Mines, 1904—; President of New Mexico School of Mines 1906—.

EMMET ADDIS DRAKE, A. M., *Professor of Languages.*

A. B. Wisconsin University, 1882: A. M., Wisconsin University, 1887. Assistant Engineer, Northern Pacific Railroad Co., 1882-1883; Instructor in Rhetoric and Oratory, Wisconsin University, 1883-1884; Instructor in Missouri School of Mines 1884-1891; General Manager, Columbia Mining Co., 1891-1897; Profesor of Languages. New Mexico School of Mines, 1897.—; Editor Socorro Chieftain, 1900.—

OLIVER RUSSELL SMITH, B. S., C. E., *Professor of Civil Engineering.*

B. S., Kansas State Agricultural College, 1898; C. E., New Mexico School of Mines, 1902; Graduate student Kansas State Agricultural College, 1898-1899; Graduate student, Kansas State University 1899-1901; Instructor in Mathematics and Draughting, New Mexico School of Mines, 1900-1902; Assistant Surveyor United States General Land Office, 1902; Assistant Professor of Engineering, Surveying and Draughting, New Mexico School of Mines 1902; City Engineer of Socorro, 1902—; United States Deputy Mineral Surveyor, 1903—; Professor of Civil Engineering 1903-1907.

REINOLD VERNON SMITH, B. S., *Professor of Mining and Metallurgy.*

B. S., University of Utah, 1895; Superintendent of Schools, Bingham, Utah, 1895-1896; Purchasing Agent, R. G., S. M. and P. Ry., Juarez Mexico, 1896-1898; With Smith and Lyon, Mining Engineers, Salt Lake City, Utah, 1898-1900; Metallurgist, Dexter-Tuscarora Consolidated Gold Mining Co., Tuscarora, Nevada, 1900-1903; Metallurgist, Mercur Consolidated Gold Mining Co., Mercur, Utah, 1903; Metallurgical Engineer, Sevier Consolidated Gold Mining Co,, Sevier, Utah, 1903-1904; Instructor in Chemistry and Physics, University of Utah, 1904-1906; Professor of Mining and Metallurgy, New Mexico School of Mines, 1906—.

CLIFTON JAMES SARLE, M. S., PH. D., *Professor of Geology and Mineralogy.*

B. S., University of Rochester, 1902; Assistant in Geology, 900-1902; M. S., Geology, University of Rochester, 1903: Instructor in Historical Geology, Sheffield Scientific School. Yale University, 1904; Ph. D., Paleontology, Yale University, 1906; Professor of Geology and Mineralogy New Mexico School of Mines, 1906-1907.

....* *Professor of Mathematics.*

*Position to be filled for 1907-1908.

RALPH WALDO TWINING, A. B., *Principal of the Academy.*

A. B. Ottawa University, Ottawa, Kansas, 1901; Principal of Homestead Public School, 1902; Graduate student and Instructor of English, Ottawa University, 1903; Principal of Santa Fe High School, 1904; Principal of the Academy of the New Mexico School of Mines, 1905—.

MISS ANNE W. FITCH .... *Registrar*

LECTURERS

CHARLES C. DUNCAN, M. D.,
Lecturer on Hygiene and "First Aid."

JAMES G. FITCH,
Lecturer on Mining Law.

NEW MEXICO SCHOOL OF MINES.

HISTORICAL SKETCH.

The New Mexico School of Mines is an institution founded by act of the Legislature of 1889. This act provided for the support of the School by an annual tax of one-fifth of a cent on all taxable property.

Under an act of the Legislature, approved February 28, 1891, a board of trustees was appointed, an organization effected and immediate steps were taken towards the erection of necessary buildings. During this same year, a special appropriation of $4,000 was made for the partial equipment of the chemical and metallurgical laboratories.

Early in 1892, a Circular of Information, regarding the New Mexico School of Mines, at Socorro, New Mexico, was issued by the Board of Trustees. In this circular, the aims were fully set forth. The following year, a president was chosen and students in chemistry were admitted; but it was not until the autumn of 1895 that the Mining School was really opened.

In 1893 a second special appropriation of $31,420 was made, to enable the School of Mines to be organized in accordance with the policy outlined by the act creating the institution.

By Act of Congress, approved June 21, 1895, the New Mexico School of Mines received for its share of certain grants of land, fifty thousand acres for its support and maintenance. From this source of revenue, the School has already received more than $17,000.

In 1899, the Legislature increased the former levy of one-fifth of a cent to twenty-seven and one-half one-hundredths of a mill.

In 1901, the 34th General Assembly recognized the growing importance of the School by further increasing the tax levy to thirty-three one-hundredths of a mill. It also authorized the bonding of any portion of the grant of lands in order to

more thoroughly equip the School with buildings and apparatus.

In 1903, the 35th General Assembly raised the millage to forty-five hundredths of a mill. This, with greatly increased assessed valuation of property, doubled the income of the School over that of the previous year.

In 1905, an appropiation of $14,000 was made by the Legislature for the maintenance of the School.

In 1907, this appropriation was increased to $15,000, and an additional appropriation of $15,000 was made for the purpose of erecting a dormitory.

STATUTES RELATING TO THE SCHOOL.

Some of the sections of the act creating the School of Mines are as follows:

The object of the School of Mines created, established and located by this act is to furnish facilities for the education of such persons as may desire to receive instruction in chemistry, metallurgy, mineralogy, geology, mining, milling, engineering, mathematics, mechanics, drawing, the fundamental laws of the United States and the rights and duties of citizenship, and such other courses of study, not including agriculture, as may be prescribed by the Board of Trustees.

The management and control of said School of Mines, the care and preservation of all property of which it shall become possessed, the erection and construction of all buildings necessary for its use, and the disbursement and expenditure of all moneys appropriated by this act, or which shall otherwise come into its possession, shall be vested in a board of five trustees, who shall be qualified voters and owners of real estate; and said trustees shall possess the same qualifications, shall be appointed in the same way, and their terms of office shall be the same, vacancies shall be filled in like manner, as is provided in sections 9 and 10 of this act. Said trustees and their successors in office shall constitute a body corporate under the name and style of "The Trustees of the New Mexico School of Mines," with right as such of suing and being sued, of contracting and being contracted with, of making and using a common seal and altering the same at pleasure, and of causing all things to be done necessary to carry

out the provisions of this act. A majority of the board shall constitute a quorum for the transaction of business, but a less number may adjourn from time to time.

The immediate government of their several departments shall be intrusted to the several faculties.

The board of trustees shall have power to confer such degrees and grant such diplomas as are usually conferred and granted by other similar schools.

The trustees shall have power to remove any officer, tutor or instructor or employee connected with said school when, in their judgment, the best interests of said school require it.

The board of trustees shall require such compensation for all assays, analyses, mill-tests, or other services performed by said institution as they may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines for said institution, and an accurate account thereof shall be kept in a book provided for that purpose.

LOCATION.

The New Mexico School of Mines is located at Socorro, the capital of Socorro County, in the central part of the commonwealth. The location is on the main line of the Atchison Topeka and Santa Fe railroad, 75 miles south of Albuquerque, and 180 miles north of El Paso. The Magdalena branch of the Santa Fe railway starts from this place.

Socorro is pleasantly situated in the broad valley of the Rio Grande, at the foot of the Socorro range of mountains. The altitude of the town is about 4,600 feet above the sea. The location is pre-eminently pleasant and healthful. The city has long been attractive to health-seekers who wish a mild, dry and invigorating climate, and many persons every year have sought its hospitalities. It is one of the ideal residence places of the region. The scenery is quite diversified by plains, broad valley slopes, mesas, varied hill country and lofty mountains. In the city are two hotels and a number of good boarding houses. The churches represented are the Presbyterian, Roman Catholic and Episcopal.

Socorro has a system of public water supply. The water is very soft and pure, and is furnished by hot springs which,

four miles away, issue from the Socorro mountain. Two newspapers are published and a modern artificial ice plant and a large roller-process flouring mill are in operation.

The ground immediately adjacent to the School of Mines includes irrigable land, plateaus and mountain formations, all affording an excellent field for practice in surveying, the laying out of a railroads and irrigating canals, topography, mine engineering and geology, so that students can be prepared at the very door of the School in those branches which usually require tedious excursions from most other schools.

The New Mexico School of Mines enjoys the natural advantage of being located in the midst of a region peculiarly rich in minerals of nearly all kinds, and is within easy reach of the most varied geological conditions, all of which are within a radius of a score of miles of Socorro. Almost the entire geological column from the precious metal-bearing formations of the Archean to the coal beds of the Tertiary is here exposed. The industrial processes connected with mining and metallurgy may be seen admirably illustrated at Magdalena, Kelly, Rosedale, San Pedro, Hillsboro, Cook's Peak, Silver City, Pinos Altos, Los Cerrillos, Gallup, Carthage, and elsewhere within easy reach of the School. These illustrate the most modern methods of mining, milling, ore-dressing, concentrating, smelting, lixiviation, chlorination and other metallurgical processes.

A large number of mines of all kinds, smelters, irrigating systems and other engineering works are accessible to the School. Within a few hours' ride by rail, are many important mining camps. The longer excursions bring the student to some of the most famous mines in southwestern United States. Some of the longest worked lodes in America are in this region. For more than 350 years they have yielded their wealth to the European and, centuries before his advent, gave up even greater treasures to the native races.

If we look into the history of modern mining schools, we find that each becomes most celebrated along the line for which its locality is best known on account of its natural surroundings. Few institutions of learning are more dependent for success upon what may be called the accident of geographical location than the mining school. It may be truth-

fully said that no mining school is more fortunately situated so far as natural environment is concerned than that of New Mexico.

PURPOSE.

The ideal to which the New Mexico School of Mines tenaciusly holds is the practical directing of young men to take active part in the development of the mineral wealth of our country and the world.

The New Mexico School of Mines is a territorial institution. It was established primarily to promote mining and mining interests in southwestern United States. However, it has a much wider scope, providing, as it does, adequate facilities for thorough training in the methods of modern mining, and meeting the demands for a mining education, not only from young men who are residents of New Mexico, but from students from other parts of the country desiring to avail themselves of the peculiar advantages of this region.

During the entire period of his training the fact is impressed upon the student that intelligent mining is strictly a business operation, that mining is today as capable of being put on a secure business foundation as any manufacturing enterprise; that from start to finish it is a proposition akin to all the great business workings, such as enable the railroad train or the ocean liner to run with certainty and dispatch; that while "lucky finds" will continue to be made, mining as a business is no longer a vast lottery, ever developing to their fullest extent the gambling propensities of mankind.

During the past quarter of a century the development of the mineral wealth of the Nation has been phenomenal. Of late the call for adequately prepared young men to direct mining enterprises in all their various ramifications has been unprecedented.

ADVANTAGES.

Several features contribute to the success of this institution as a school of mines.

The unique natural surrounding of the School, already described, create an invigorating mining atmosphere which

is entirely wanting in situations away from the mines and mountains.

In the training offered by the School there is noteworthy concentration of effort. There are many advantages in the direction of effort along few lines. In contrast with the many diversions that necessarily exist in most technical institutions of learning, where all practical branches are equally represented, singleness of purpose is a leading feature in the New Mexico School of Mines. The conservation of energy growing out of the special method of instruction happily adapts the student so that he gets the most out of his efforts.

The student is required as an integral part of his course, to visit and critically inspect under the direct supervision of his instructors, various plants and works, and to make intelligent reports. Being obliged from the start to make the most of the exceptional opportunities presented, he quickly falls into the spirit of his present and future work, and at once necessarily acquires for his chosen profession a sympathy that is seldom attained except after school days are over and after long and strenuous effort.

Being within short distances of mines and smelters, the student has the opportunity of finding regular employment during his vacation and of acquiring desirable experience in practical work.

The field for scientific research in New Mexico is unrivalled by any other mining region and the opportunities here offered are not neglected in the plan and scope of instruction. New Mexico, so far as concerns the mountainous portion, which comprises nearly two-thirds of its area and is nearly all mineral-bearing, is perhaps less known geologically than any other section of the United States. A little study of the plateau region of the northwestern portion of the territory has been made by the United States Geological Survey, but only in a general way. No attempt has ever been made, under government auspices, to investigate closely the geological structure of New Mexico mountains such as has been carries out in the other Rocky Mountain states, or to study the conditions of New Mexican mineral deposits, as has been done in Colorado by Emmons, in Nevada by Curtis, in Cali-

fornia by Becker, and in other states by other distinguished investigators.

It is proposed that much of the advanced professional work of the school shall be of an original nature, to the end that the graduates may be skilled, theoretically and practically, in the very problems which they, as professional men, will be called upon to solve. This work will be carried on by the advanced students, under the direction of the professors, and will involve the collection of notes, sketches, maps and specimens, and the results of directed observation in all matters relating to the sciences and arts embraced in the courses of study. The subjects for such researches in geology and mining, and in the reduction of the ores of lead, silver, gold and copper are so numerous that is impossible to do more here than to mention the fact that the conditions of climate, drainage, water-supply and geological structure in New Mexico differ greatly from the conditions existing in others part of the Rocky Mountains, giving rise to new problems in practice. These problems are not by any means all that deserve attention. The investigations of the ores of iron, manganese, aluminum, cobalt, nickel, tin and quicksilver, together with the beds of coal, salt, alums, building stones, mineral-paints, cement-rocks, marls, etc., will be directly in the line of the advanced laboratory work of the School, and every student who undertakes such work will be encouraged in every way possible to accomplish the best re sults.

ORGANIZATION.

The general management of the New Mexico School of Mines is vested in a Board of Trustees consisting of five members appointed by the Governor of the Territory with the concurrence of the Council for a term of four years. The Board of Trustees elect a President from its members and also a Secretary and Treasurer. The appointment of a president of the faculty of the School is also made by them.

By act of the legislature, the maintenance of a preparatory department is required of the higher educational institutions of the Territory. The New Mexico School of Mines, therefore, is composed of the Academy and the College.

THE ACADEMY.

Candidates for admission to the Academy must show a satisfactory degree of proficiency in the subject usually taught in the eighth and preceding grades of the common schools.

The courses offered in the Academy are:

First Year.

First Semester: Algebra, English, Latin and Physiography.

Second Semester: Algebra (thru quadratic equations), English, Latin and Physiology.

Second Year.

First Semester: Geometry, English, Latin and Zoology.

Second Semester: Geometry (thru Solid Geometry) English Latin and Botany.

THE COLLEGE.

The Requirements for Admission.

Candidates for admission to the College must show, either by examination or by the presentation of statements from schools of recognized standing, a satisfactory degree of proficiency in those subjects required in the Academy or in other subjects which are accepted as equivalent to the Academy subjects.

Advanced Standing.

Credits for courses required in the College will be given to students either upon their passing an examination in such courses or upon their presentation of a certificate from an approved educational institution showing that they have satisfactorilycompleted such courses; provided that no more than the first two years of the college courses be thus credited. Certificates of credit for such courses should be presented, or examinations for credits should be arranged for, at the time of matriculation.

Students who have matriculated with the intention of graduating but whose preparatory work is incomplete, will be required to complete such work and become regular as soon as possible.

It cannot be urged too strongly that students expecting to

matriculate with this institution come prepared to take up the work without conditions. Every candidate for admission to the school may rest assured that after entrance his time will be fully occupied.

Special Courses.

Students not intending to graduate, but desiring to take special courses, may be registered for such courses; provided they give evidence of proficiency in the prerequisite subjects and provided their acceptance into such courses does not necessitate an unsatisfactory schedule of classes.

Curricula.

The curricula of the College are planned especially to meet the needs of students intendings to engage in mining or metallurgical industries, in mine-experting or in surveying mines and mining lands. Accordingly, curricula are offered in the following:

MINING ENGINEERING.

METALLURGICAL ENGINEERING.

MINING GEOLOGY.

CIVIL ENGINEERING.

Each curriculum covers four years. Upon the satisfactory completion of the courses of the first three years, the bachelor's degree is given; and at the end of the year following (the fourth year) the engineer's degree is conferred.

In the adjustment of the courses of the several curricula, it was assumed that one hour's work in the class-room requires two hours of preparation, and therefore that one hour's work in the class-room is equivalent to three hours' work in the field or in the laboratory. In the following outlined statement of curricula, the number of hours per week required in the class-room (C. R.) and in the field or in the laboratory (F. or L.) are given separately. The number of hours required in the field or in the laboratory represents *average* time however, inasmuch as it is frequently advantageous, especially for field-work, to concentrate into one week an amount of work equal to that which would require two or more weeks if performed in separate installments.

MINING ENGINEERING.

MINING ENGINEERING.

FIRST YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK. First Semester. C. R.	First Semester. F. or L	Second Semester. C. L.	Second Semester. F. or L
I.	5.	College Algebra....................	5		5	
I.	6.	Trigonometry	5			
I.	7.	Analytical Geometry			4	
VI.	1.	General Surveying..................			3	4
I.	3.	Descriptive Geometry.............	3			
I.	4.	Mechanical Drawing and Lettering		4		4
VI.	3.	Free-hand Drawing................		3		
III.	1. 2.	General Chemistry................	4	6	3	
III.	3.	Qualitative Chemical Analysis.....			1	6
III.	4.	Blowpipe Analysis.................				3
V.	1.	Spanish (or German or French)....	2½		2½	
IV.	3.	Hygiene and First-aid..............				

MINING ENGINEERING.

SECOND YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK First Semester. C. R.	First Semester. F. or L.	Second Semester. C. R.	Second Semester. F. or L.
II.	8.	Calculus....	4		4	
VI.	2.	Plotting Surveys..................	2			
VI.	4.	Mine Surveying....................		4		
VI.	6.	Topographical Drawing				2
II.	1, 2.	General Physics....................	5	3	4	
II.	6.	Power and Power Transmission...			3	
II.	7.	Engine Laboratory				1
VI.	8.	Masonry Construction			3	
VII.	1, 2.	Mineralogy	3	3	2	3
III.	5.	Quantitative Chemical Analysis...	1	6		
IX.	1.	Fire Assaying......................			1	8
III.	6, 7.	Fuel and Water Analysis.........	1	3		3
V.	2.	Spanish (or German or French)....	2½		2½	

MINING ENGINEERING.

THIRD YEAR.

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	First Semester. F. or L.	Second Semester. C. S.	Second Semester. F. or L.
II. 4,	Analytical Mechanics	5			
II. 8.	Hydraulics	4			
VI. 11.	Stresses			3	
II. 5.	Machine Design			2	4
VIII. 5	Ore Dressing			3	
VIII. 1, 2.	Mining Methods	5		3	
VIII. 3.	Examination of Mining Methods				5
VII. 3.	Principles of Geology	3	3	3	3
VII. 4, 5.	Economic Geology	2		2	
III. 8.	Wet Assaying		6		
IX. 3.	General Metallurgy	3			
IX. 11.	Metallurgical Laboratory				4

MINING ENGINEERING.

FOURTH YEAR.

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	First Semester. F. or L.	Second Semester. C. R.	Second Semester. F. or L.
VI. 12.	Graphical Statics			3	5
VI. 13.	Structural Details, A	2	6	2	6
VIII. 7.	Mine-Plant Design		6		6
VIII. 6.	Mine Plant	3		3	
VIII. 4.	Mine Examination		10		
	Ore-Dressing Plant Design		4		
VII. 14.	Ore Deposits	4	3		
IX. 7.	Metallurgy of Iron	2			
VIII. 9.	Mining Law	½			
VIII. 8.	Mine Administration and Accounts	2			
VI. 16.	Contracts and Specifications	2			
	Thesis				35

METALLURGICAL ENGINEERING.

METALLURGICAL ENGINEERING.
SECOND YEAR.*

Course Numbers.		COURSES.	HOURS PER WEEK. First Semester. C. R.	F. or L.	Second Semester. C. R.	F. or L.
I.	8.	Calculus..........	4		4	
VI.	2.	Plotting Surveys....................		2		
II.	1, 2.	General Physics......	5	3	4	
II.	6.	Power and Power Transmission...			3	
II.	7.	Engine Laboratory..................				1
VII.	1, 2.	Mineralogy.......	3	3	2	3
IX.	3.	General Metallurgy.	3			
IX.	11.	Metallurgical Laboratory..........				4
IX.	4.	Metallurgy of Lead.................			2	
III.	5.	Quantitative Chemical Analysis. .	1	6		
IX.	1.	Fire Assaying.......................			1	8
III.	6, 7.	Fuel and Water Analysis..........	1			6
V.	2.	Spanish (or German or French)....	2½		2½	

METALLURGICAL ENGINEERING.
THIRD YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK. First Semester. C. R.	F. or L.	Second Semester. C. R.	F. or L.
II.	4.	Analytical Mechanics.............	5			
II.	8.	Hydraulics..........................	4			
VI.	11.	Stresses..........			3	
II.	5.	Machine Design....................			2	4
VIII.	5.	Ore-Dressing......			3	
VIII.	1, 2.	Mining Methods................	5		3	
VII.	3.	Principles of Geology..............	3	3	3	3
VII.	4, 5.	Economic Geology.................	2		2	
III.	8.	Wet Assaying.......................		6		
III.	9.	Iron and Steel Analysis...........		3		3
IX	5 (or 7)	Metallurgy of Copper (or Iron)....	2			
IX.	6.	Metallurgy of Gold and Silver......			2	

*The courses of the first year are the same as in the first year of Mining Engineering.

METALLURGICAL ENGINEERING.

FOURTH YEAR.

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester C. R.	First Semester F. or L.	Second Semester. C. R.	Second Semester. F. or L.
VI. 12.	Graphical Statics...			3	5
VI. 13.	Structural Details, A...............	2	6	2	6
VIII. 6.	Mine Plant	3		3	
	Ore-Dressing Plant Design........ .		4		
VII. 14.	Ore-Deposits..........	4	3		
IX. 5 or 7.	Metallurgy of Copper or of Iron...	2			
IX. 8.	Metallurgical Inspection..........		10		
IX. 9.	Metallurgical Design...............		6		6
VIII. 8.	Mine Administration and Accounts	2			
VI. 16.	Contracts and Specifications......	2			
	Thesis......				35

MINING GEOLOGY.

MINING GEOLOGY.

SECOND YEAR.*

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	First Semester. F. or L.	Second Semester. C. R.	Second Semester. F. or L.
VI. 4.	Mine Surveying	2	4		
VI. 2.	Plotting Surveys		2		
II. 1, 2.	General Physics	5	3	4	
VII. 1, 2	Mineralogy	3	3	2	3
VII. 3.	Principles of Geology	3	3	3	3
VII. 4, 5,	Economic Geology	2		2	
III. 5.	Quantitative Chemical Analysis	1	6		
IX. 1.	Fire Assaying			1	8
III. 10.	Rock Analysis				6
IV. 1.	General Biology			1	3
V. 2.	Spanish (or German or French).1	2½		2½	

MINING GEOLOGY.

THIRD YEAR.

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	First Semester. F. or L.	Second Semester. C. R.	Second Semester. F. or L.
VII. 6.	Dynamical Geology	3	3		
VII. 7.	Structural Geology				
VII. 8.	Stratigraphical Geology			6	3
VII. 9.	Practical Geology	1			
VII. 10.	Topographical Mapping		6		
VII. 11.	Geological Surveying, A			1	6
IV. 2.	Paleontology	2	3	2	3
VII. 13.	Petrography	3	6	3	6
VII. 14.	Ore-Deposits	4	3		
VIII. 1, 2.	Mining Methods	5		3	
VII. 15.	Special Problems				12

* The courses of the first year are the same as in the first year of Mining Engineering.

MINING GEOLOGY.

FOURTH YEAR.

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	HOURS PER WEEK. First Semester. F. or L	HOURS PER WEEK. Second Semester. C. R.	HOURS PER WEEK. Second Semester. F. or L.
VII. 12.	Geological Surveying, B...........				
VII. 16.	Geological Correlation.............				
VII. 17, 18.	Ore Deposition.........................				
VII 19.	Geological Philosophy..............				
VII. 20.	History of Geology..................				
VII. 21.	Research......				
VII. 22.	Thesis...............................				

The time for these courses will be apportioned later.

CIVIL ENGINEERING.

CIVIL ENGINEERING.
SECOND YEAR.*

Course Numbers		COURSES.	HOURS PER WEEK. First Semester. C. R.	First Semester. F. or L.	Second Semester. C. R.	Second Semester. F. or L.
I.	8.	Calculus	4		4	
VI.	2.	Plotting Surveys		2		
VI.	4.	Mine Surveying	2	4		
VI.	6.	Topographical Drawing				2
II.	1, 2.	General Physics	5	3	4	
VI.	8.	Masonry Construction			3	
VII.	1, 2.	Mineralogy	3	3	2	3
III.	5.	Quantitative Chemical Analysis	1	6		
I.	9.	Mathematical Astronomy	3			
VI.	5.	Railway Surveying			3	6
VI.	7.	Roads and Pavements			2	
V.	2.	Spanish (or German or French)	2½		2½	

CIVIL ENGINEERING.
THIRD YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK. First Semester C. R.	First Semester F. or L.	Second Semester. C. R.	Second Semester. F. or L.
II.	4.	Analytical Mechanics	5			
II.	8.	Hydraulics	4			
VI.	11.	Stresses			3	
VII.	3.	Principles of Geology	3	3	3	3
I.	10.	Method of Least Squares	2			
VI.	12.	Graphical Statics			3	5
VI.	10.	Railway Location			3	
VI.	9.	Sanitary Engineering	2			
VI.	17.	Water Supply			3	
III.	6, 7.	Fuel and Water Analysis	1	3		3
IX.	7.	Metallurgy of Iron	2			
III.	9.	Iron and Steel Analysis		3		3
		Spanish (German or French)	2½		2½	

*The courses of the first year are the same as in the first year of Mining Engineering.

CIVIL ENGINEERING.

(Structural Engineering.)

FOURTH YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK.			
			First Semester.		Second Semester.	
			C. R.	F. or L.	C. R.	F. or L.
VI.	13.	Structural Details, A	2	6	2	6
VI.	18.	Sewerage and Drainage	3			
II.	6.	Power and Power Transmission			3	
VI.	15.	Concrete Structures	5		2	
VI.	14.	Structural Details, B	2	9	2	9
I.	11.	Geodesy			5	3
VI.	16.	Contracts and Specifications	2			
		Collateral Reading		18		6
		Thesis				15

CIVIL ENGINEERING.

(Hydraulic and Irrigation Engineering.)

FOURTH YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK.			
			First Semester.		Second Semester.	
			C. R.	F. or L.	C. R.	F. or L.
VI.	13.	Structural Details, A	2	6	2	6
VI.	18.	Sewerage and Drainage	3			
II.	6.	Power and Power Transmission			3	
VI.	15.	Concrete Structure	5			
VI.	20.	Hydraulic and Masonry Design	1	6	1	6
VI.	19.	Irrigation Engineering	3			
VI.	21.	Irrigation Structures			2	
I.	11.	Geodesy			5	3
VI.	16.	Contracts and Specifications	2			
		Collateral Reading		15		6
		Thesis				15

CIVIL ENGINEERING.

(Sanitary Engineering.)

FOURTH YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK. First Semester. C. R.	First Semester. F. or L.	Second Semester. C. R.	Second Semester. F or L.
VI.	13.	Structural Details, A	2	6	2	6
VI.	18.	Sewerage and Drainage	3			
II.	6.	Power and Power Transmission			3	
VI.	15.	Concrete Structures	5			
VI.	20.	Hydraulic and Masonry Design	1	6	1	6
I.	11.	Geodesy			5	3
VI.	16.	Contracts and Specifications	2			
		Collateral Reading		24		12
		Thesis				15

DEPARTMENTS OF INSTRUCTION.

I. DEPARTMENT OF MATHEMATICS.

Constituting as they do, the foundation of the several curricula offered by the School, the various subjects in mathematics are given first attention. The instruction has a double purpose: to cultivate in the student the faculty of independent reasoning, by practice in the development of formulas and other mathematical propositions; to make him familiar with the applications of these mathematical principles to the solution of such practical problems as may confront him in his professional career.

The first year's work in the College assumes that the student has satisfactorily completed Courses 1 and 2 of this department. Students who have not completed these courses may pursue them in the Academy, but, on account of the number and sequence of the mathematical subjects required in the College, they are strongly urged to come prepared in the two subjects referred to.

1. Elementary Algebra.

The subject of quadratic equations and those algebraic subjects which usually precede it are studied, formulae are developed and problems are solved.

Time: Class-room, five hours a week, one year.

Text: Wentworth, *Elementary Algebra.*

2. Elements of Geometry. Professor DRAKE.

This includes both Plane Geometry and the Geometry of Space supplemented by numerous problems in demonstration, construction and computation.

Prerequisite: Course 1 of this department.

Time: Class-room, five hours a week, one year.

Text: Phillip and Fisher, *Elements of Geometry.*

3. Descriptive Geometry. Professor O. R. SMITH.

The representation of all geometrical magnitudes by means of orthographic projection, the solution of problems involving

points, lines, surfaces and solids, descriptions of and problems relative to warped and double-curved surfaces, intersections of lines and surfaces.

Prerequisite: Course 2 of this department.

Time: Class-room, three hours a week, first semester

Text: Church, *Descriptive Geometry.*

4. Mechanical Drawing and Lettering.

Professor O. R. SMITH.

This course comprises the drawing of 20 plates in the geometrical representation of objects by isometric and orthographic projections. Objects in various positions are projected ortographically and the relations between the different views are brought out; sections at different positions and the intersections of solids are represented. The principles of linear perspective are discussed and applied to the representation of some simple objects.

The latter part of the semester is devoted to special practice in lettering and in the construction of appropriate and attractive letters for maps and engineering plans.

Prerequisite: Course 2 of this department.

Time: Laboratory, four hours a week, one year.

Text: Tracy, *Mechanical Drawing.*

5. College Algebra.

Professor DRAKE.

Quadratic equations, fractional and negative indices, imaginary and complex quantities, the progressions and other simple series, inequalities and limits, permutations and combinations, binominal theorem for any index, undetermined coefficients, exponentials and logarithms, terminants, and elements of the theory of equations.

Prerequisite: Course 1 of this department.

Time: Class-room, five hours a week, one year.

Text: Wentworth, *College Algebra.*

6. Trigonometry.

Professor DRAKE.

A combination of the ratio and line systems is used, special attention is given to the transformation of trigonometric expressions, solutions of trigonometric equations, and rigorous dealing with the fundamental series of trigonometry.

Spherical trigonometry is also studied, the solution of spherical triangles and the application of spherical trigonometry to the simple problems of spherical astronomy being included.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, five hours a week, first semester.

Text: Phillips and Strong, *Elements of Plane and Spherical Trigonometry.*

7. **Analytic Geometry.** Professor DRAKE.

The analytic geometry of the straight line, the circle, and the conic sections, is covered. The course includes also the transformation of co-ordinates, a discussion of the general equation of the second degree, and an introduction to the analytic geometry of space.

Prerequisite: Course 6 of this department.

Time; Class-room, four hours a week, second semester.

Text: Ashton, *Plane and Solid Analytic Geometry.*

8. **Calculus.** Professor R. V. SMITH.

The subjects treated are the development of the basic principles and formulae of the calculus; differentation of functions, development of functions into series, evaluation of indeterminate forms; maxima, minima, lengths of curves, areas, volumes, centers of gravity, and other applications of the methods of differentiation and integration to problems in geometry and analysis.

Prerequisites: Courses 5 and 7 of this department.

Time; Class-room, four hours a week, one year.

Text: Osborne, *Differential and Integral Calculus.*

9. **Mathematical Astronomy.** Professor O. R. SMITH.

This course is intended to give the student practical knowledge of those principles of astronomy which are the foundation of geodesy. It comprises discussions of the sun, planets, satellites and stars, of their apparent motions and of the determination of their positions in the celestial sphere. Astronomical instruments, the sextant, transit, zenith-telescope, altazimuth, their adjustments and uses, are explained.

Special attention is given to the methods of determining latitude, time and azimuth.

Prerequisites: Courses 2, 5 and 6 of this department.

Time: Class-room, three hours a week, first semester.

Text: Barlow, *Mathematical Astronomy.*

10. Method of Least Squares. Professor O. R. SMITH.

Observation errors and the determination of true value from numerous observations; residuals, weights, normal equations for determining average value; conditional observations, probable error, interpolation formulas.

Prerequisite: Course 8 of this department.

Time: Class-room, two hours a week, first semester.

Text: Johnson, *Least Squares:*

11. Geodesy. Professor O. R. SMITH.

The Earth, planets, satellites and stars, their astronomical positions and apparent motions, computation of right ascension and declination, description, adjustment and use of the sextant, astronomical transit, zenith-telescope and azimuth, and their applications to the determination of time and terrestrial latitude, longitude and azimuth.

Prerequisites: Courses 9 and 10 of this department.

Time: Class-room, five hours a week, second semester.
Field, three hours a week, second semester.

Text: Hayford, *Geodetic Astronomy.*

II. DEPARTMENT OF PHYSICS AND MECHANICS.

I General Physics. Professor R. V. SMITH.

Mechanics, molecular physics and heat are studied.

The class work consists of lectures, demonstrations, recitations and the solution of assigned problems.

The laboratory-work is so arranged as to exemplify the principles discussed in class and is quantitative in character, the qualitative experiments being performed in the class-room. The laboratory work consists of the following experiments: (1) Uniformly accelerated motion; (2) Relation of force to mass and to acceleration; (3) Composition and resolution of forces; (4) Moments; (5) Energy and efficiency; (6) Inelastic impact; (7) Elastic impact; (8) Young's modulus; (9) Moments of torsion and coefficients of rigidity; (10) Moment of inertia; (11) Simple harmonic motion; (12) Centripetal force; (13) Pressure-expansion of gases; (14) Heat-expansion of gases; (15) Archimedes's principle; (16) Calorimetry.

This course is intended not only to familiarize the student with the manner of making accurate determinations, of properly manipulating and adjusting the instruments used in making precise measurements, and of intelligently recording, interpreting and reducing the data obtained, but also to give him a better understanding of the laws of physics and of the real significance of physical constants.

Prerequisite: Course 6 of Deparment I.

Time: Class-room, five hours a week, first semester.
Laboratory, three hours a week, first semester.

Texts: Millikan, *Mechanics, Molecular Physics and Heat.*
Carhart, *University Physics.*
Merrill, *Theoretical Mechanics.*

2. General Physics. Professor R. V. SMITH.

A continuation of Course 1. Sound, light, electricity and magnetism are studied.

Prerequisite: Course 1 of this department.

Time: Class-room, four hours a week, second semester.

Text: Carhart, *University Physics.*

4. Analytical Mechanics. Professor O. R. SMITH.

The Mechanics of Materials deals with the stresses and deformations produced in bodies of various forms and materials, by forces variously applied. First, moments of inertia and radii of gyration of plane figures and solids are treated in detail; then follow the theories of tension, compression of long and short columns, shear and torsion; flexure of beams, elastic curves and safe loads; continuous beams, the theorem of three moments and graphical solutions; introduction to graphic statics. The application of theoretical formulas to the solution of practical engineering problems is mastered by many numerical computations.

Prerequisites: Course 1 of this department and Course 8 of Department I.

Time: Class-room, 5 hours a week, first semester.

Text: Church, *Mechanics of Engineering.*

5. Machine Design. Professor O. R. SMITH

The work is confined to such problems as a mining engineer is most likely to be confronted with. Lectures and recitations using Unwin's Machine Design, Part I, as a reference, are carried on. Problems in rivetted joints, in the use of structural steel and iron for long columns and girders and in the use of timber are assigned.

In the draughting-room, drawings are made of the various parts of air drillls or of some other machinery in the department. The main object of this drawing practice is to familiarize the students with shop requirements in regard to such draughts and so that working draughts may become perfectly intelligible. The students are aided in this matter by sets of blue-prints which have been presented to the school by leading manufacturers of mining machinery. In the latter part of the course the problems taken up in the lectures are made the subject of the draughting-room work.

Prerequisite: Course 2 of this department, Course 3 preceding or accompanying.

Time: Class-room, two hours a week, second semester.
Laboratory, four hours a week, second semester.

6. Power and Power Transmission. Professor R. V. Smith

The various sources of power are discussed briefly, steam and other heat engines as the great sources of power being studied in considerable detail; the boiler and furnace with their accessories; the engine with its connections and controlling mechanism.

Lectures are given on the transmission of power by shafting, gearing and compressed air; water-power and electric transmission and distribution of power; the general principles of the transmission and transformation of electrical energy.

Prerequisite: Course 1 of this department.

Time: Class-room, three hours a week, second semester.

Text; Hutton. *Mechanical Engineering of Power Plants.*

7. Engine Laboratory. Professor R. V. Smith

This course is intended to accompany Course 6 of this department. It consists of the inspection and classification of engines from an examination of their parts; mechanisms; problems in valve-gearing and setting; measurement of engine constants, and indicated, and brake, horse-powers; indicators and diagrams; governors; cylinder and stuffiing-box packing; the lining up and care of shafting; pulleys, belting, and rope-drives; the safety inspection of boilers; boiler setting and connections; testing of boiler shells, care of flues; the use of pumps and injectors.

Time: One hour a week (average), second semester.

8. Hydraulics and Hydraulic Machinery.

Professor O. R. Smith.

Theoretical hydraulics, head and pressure velocity and path of a jet; instruments and measurements; practical formulae; flow of water through orifices, weirs, tubes, pipes and open channels; losses of head, hydraulic gradient; nozzles, river-gauging, dynamic force of water; water-wheels, overshot, breast and undershot; turbines and impulse wheels; pumps, reciprocating and rotary, and pumping machinery.

Prerequisites: Course 3 of this department, Course 4 accompanying or preceding.

Time: Class-room, four hours a week, first semester.

Text: Merriman, *Treatise on Hydraulics.*

III. DEPARTMENT OF CHEMISTRY.

ROBERT PEELLE NOBLE, PROFESSOR,
O. D. ROBBINS, Laboratory Assistant.

The excellent equipment of the chemical laboratory (elsewhere described) makes it possible to offer a number of advanced courses essential to chemical engineering, in addition to those required by the curricula already outlined. These courses are designated *special* and will be given upon the request of a sufficient number of students.

It is the intention to secure as perfect a correlation as possible between the lectures, the quizzes and the laboratory-work, in order that the greatest efficiency in instruction may be attained.

1. General Chemistry, A.

This course is introductory to all engineering, metallurgical and geological courses and is intended to give the student a broad view of the field of inorganic chemistry by presenting to him the fundamental laws and theories of chemistry and by acquainting him with the occurrence, preparation, properties, relations and uses of the common non-metallic elements and of their compounds. With these substances, he performs in the laboratory as many experiments as the time permits, great weight being given to the making of neat and accurate records of these experiments and to the attainment of a scientific view-point. The time in the class-room is largely devoted to quizzes upon assigned subjects, ample opportunity thus being given to correct any erroneous ideas possessed by the student, and to add to his information on these subjects.

It is very desirable that one should be prepared with elementary physics before entering upon this course.

Prerequisite: Course 1 of Department I.

Time: Class-room, four hours a week, first semester.
Laboratory, six hours a week, first semester.

Texts: Noble, *Elementary Chemical Theory.*
Newth, *Inorganic Chemistry.*
Remsen and Randall, *Chemical Experiments.*

2. **General Chemistry, B.**

This is a continuation of the preceding course and comprises a study of the metals in the same manner as the nonmetals are studied in Course 1. It is intended to be taken simultaneously with Course 3.

Prerequisite: Course 1 of this department.

Time: Class-room, three hours a week, second semester.

Text: Newth, *Inorganic Chemistry.*

3. **Qualitative Analysis.**

Those reactions which are used in the separation and detection of the metals of the silver group are carried out in the laboratory and discussed in the class-room. When sufficient familiarity with these reactions has been acquired, unknown solutions containing one or more metals of this group are then analyzed and the metals detected. The metals of the copper group are then studied similarly and unknown solutions containing the metals both of the silver and copper groups are analyzed. In this manner are studied the metals of all the groups and finally the acids. When entirely familiar with the analytical procedure both for metals and acids, the student is required to analyze at least one of the following substances: Alloys, insoluble salts, industrial products, minerals, slags, mattes and speisses.

Prerequisite: Course 1 of this department. Course 2 must precede or accompany.

Time: Class-room, one hour a week, second semester. Laboratory, six hours a week second semester.

Texts: Perkin, *Qualitative Chemical Analysis.*
Fresenius, *Qualitative Chemical Analysis.*

4. **Blowpipe Analysis.**

Observations are made in the laboratory, of the flame-tests of the various metals and non-metals and of their compounds, of their behavior when subjected to the blowpipe-flame on charcoal and on plaster plates with such reagents as are commonly used, and of their behavior when fused in the borax and microcosmic beads. A number of unknown minerals are examined and their identification effected. The record-

ing of all work and the submitting of such record at the completion of the course are required.

Prerequisites: Course 1 of this department. Course 2 must precede or accompany.

Time: Laboratory, three hours a week, second semester.

Text: Landauer, *Blowpipe Analysis.*

5. Quantitative Analysis.

A course embodying the general principles of quantitative analysis and introductory to those courses involving special quantitative methods.

In the laboratory the following experiments are performed:

Gravimetric: Determinations of chlorin in a chlorid, of iron in iron wire or in ferrous ammonium sulphate, of sulphur in a sulphate, of phosphorus in apatite, of copper (electrolytically) in brass, of silica in feldspar.

Volumetric: The preparation of half-normal solutions of an acid and of an alkali, the determination of the strength of some acid or alkali, the determination of iron in an ore by the permanganate method, and the determination of silver in an ore by Volhard's method.

The class-room work consists in lectures on the use and care of balances, crucibles and desiccators, on the selection and use of indicators, on the use, care and calibration of volumetric flasks, burettes and pipettes, on the methods used in the laboratory from the standpoint of modern chemical theories, in quizzes on these topics and in the solution of stoichiometric problems involving calculations which are similar to those arising from, and essential to, the laboratory experiments.

Prerequisites: Courses 1, 2 and 3, of this department.

Time: Class-room, one hour a week, first semester.

Texts: Talbot, *Quantitative Chemical Analysis.*
Fresenius, *Quantitative Chemical Analysis.*

6. Fuel Analysis.

Analyses of various coals or of other fuels are made and their heat-values are then calculated from these analyses and also determined experimentally by means of the calorimeter. Flue-gases are analyzed and the results are interpreted. The

flash-point, burning point, specific gravity, viscosity, and acidity of oils are determined.

Lectures on the methods required for these determinations are given in the class-room.

Prerequisite: Course 5 of this department.

Time: Class-room, one hour a week, first twelve weeks of first semester.
Laboratory, six hours a week, seven weeks of second semester.

Texts: Stillman, *Engineering Chemistry.*
Hempel, *Gas Analysis.*
Gill, *Oil Analysis.*

7. Water Analysis.

Analyses of waters are made in regard to their possible use in boilers. These analyses involve determinations of total solids, organic and volatile matter, silica, aluminum and iron, calcium, magnesium, sodium and potassium, and carbonic, sulphuric and hydrochloric acids.

Lectures are given on the methods required for these determinations, on the injurious action of certain waters on boilers and on the prevention of such action.

Prerequisite: Course 5 of this department.

Time: Class-room, one hour a week, last five weeks of first semester.

Texts: Stillman, *Engineering Chemistry.*
Fresenius, *Quantitative Chemical Analysis.*

8. Wet Assaying.

A thoroly practical course in the determination of the important constituents of ores and metallurgical products. The methods taught are those in use in the large smelters of the west. The student works upon checked samples of widely varying composition until he becomes familiar with the various methods and can carry them out under all conditions with accuracy and rapidity.

A large collection of accurately checked samples are available for analysis, including many obtained from the principal smelters of the country. The regular work of the course consists in the assaying of typical ores and metallurgical pro-

ducts. By putting in extra time the ambitious student may greatly increase the number of his determinations and thus become decidely more expert in this work.

The following determinations are made; arsenic, silver, copper (both by the cyanid and iodid methods), lead by the molybdate method, zinc by the ferrocyanid method, manganese and calcium by the permanganate method.

Prerequisite: Course 5 of this department.

Time: Laboratory, six hours a week, first semester.

Texts: Low, *Technical Methods of Ore Analysis.*
Sutton, *Volumetric Analysis.*

9. Iron and Steel Analysis.

The analysis of pig-iron, wrought-iron and steel is undertaken, both accurate methods and rapid methods being considered. As many determinations of the following substances are made as the time permits; iron, sulphur, silicon, phosphorus, manganese, carbon both graphitic and combined, titanium, nickel, cobalt, chromium, aluminum are arsenic,

Prerequisite: Course 5 of this department.

Time: Laboratory, three hours a week, one year.

Text: Blair, *Chemical Analysis of Iron.*

10. Rock Analysis.

The complete analysis of sedimentary, metamorphic and igneous rocks of complex mineralogical composition. Special stress is laid upon the determination of the minute quantities of metals such as lead, copper, gold and silver present in various types of rocks. Opportunity is given to carry on special investigations along these lines.

Prerequisite: Course 5 of this department.

Time: Laboratory, six hours a week, second semester.

Texts: *Bulletin No. 148 of the U. S. Geological Survey.*
Fresenius, *Quantitative Chemical Analysis.*

11. Inorganic Preparations. (*Special.*)

Chemically pure substances of commercial importance are prepared by the student with constant attention to the securing of maximum yields. Skill in manipulation is encouraged, methods of manipulation not occurring in other courses

are practiced, and a general increased knowledge of inorganic chemistry is acquired.

Prerequisite: Course 5 of this department.

Time: Class-room, one hour a week, one semester.
Laboratory, six hours a week, one semester.

Text: Lengfeld, *Inorganic Preparations.*

12. **Industrial Inorganic Chemistry.** (*Special.*)

The utilization of inorganic materials in manufacturing processes was taken up in an elementary way in connection with general chemistry. This special industrial course goes into the subject considerably more in detail. The manufacturing processes considered are mainly those of acids, alkalies, mineral dyes, mineral paints, explosives and matches.

The aim is to expound the dominant principles underlying each process rather than to present such an account of the details as will suffice for the student of any particular industry. In this manner, the student is prepared to study efficiently the literature of any branch in which he may afterwards become especially interested.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, two hours a week, one semester.

Text: Thorp, *Outlines of Industrial Chemistry.*

13. **Organic Chemistry** (*Special*).

This course serves as an introduction to the study of the hydrocarbons of both the fatty and the aromatic series, alcohols, phenols, aldehydes, organic acids, ethers, esters, and carbohydrates. Their formation, relations and derivatives are discussed, and special attention is given to the explanation of familiar organic phenomena.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, two hours a week, one year.
Laboratory, six hours a week, one year.

Texts: Remsen, *Organic Chemistry.*
Fischer, *Preparation of Organic Compounds.*

14. **Industrial Organic Chemistry** *(Special).*

The utilization of organic materials in the industrial arts is considered. The subjects taken up are: Petroleum and mineral oils, fats and fatty oils, essential oils and resins,

cane-sugar, starch and its alteration products, fermentation, milk, vegetable textile fibres, animal textile fibres, animal tissues and their products, destructive distillation, artificial dyes, bleaching, dyeing and textile printing.

Special prominence is given to the petroleum and mineral oil industry, and to the destructive distillation of coal. The topics discussed under the first head are natural gas and its products, illuminating gas, fuel gas, lamp-black, and electric-light carbons, crude pretroleum and its products, ozokerite and natural paraffines and their products, bitumens, asphalts, bituminous shales and their products, and vaseline. Under the destructive distillation of coal are taken up the varieties of coal, distillation in the gas-retort and in the coke-ovens, fractional separation of crude coal-tar, treatment of the ammoniacal liquor, light oil, middle oil, heavy oil, anthracene, pitch, and gas.

Prerequisites; Courses 1, 2, and 13 of this department.

Time: Class-room, two hours a weeks, one semester.

Text: Thorp, *Outlines of Industrial Chemistry.*

15. **Physical and Theoretical Chemistry** *(Special).*

The elements of theoretical chemistry have already been studied in the courses in general chemistry, qualitative and quantitative analysis. The subject is here pursued more exhaustively. The principal subjects considered are: The gas laws, atomic and molecular weights and the methods of determining them, forms and the phase rule, the kinetic theory, thermochemistry, ionization, dissociation and balanced actions, electro-chemistry and photo-chemistry.

Prerequisite: Course 5 of this department.

Time: Class-room, two hours a week, one semester.

Text: Walker, *Physical Chemistry.*

IV. DEPARTMENT OF BIOLOGY.

The biological courses are offered in engineering mainly for two reasons. One is to enable the student to become somewhat familiar with the manipulation of the microscope and the preparation of material for examination, and at the same time to learn something of the minute structures presented by living forms, both animal and plant. The other is to enable the student to use the fossil organisms contained in the rocks as a guide to locate himself geologically.

1. General Biology.

The course offers a glimpse of the types of life. The simpler forms and the minute structure of the higher ones are studied by means of the microscope. As the main object is to give the student an idea of the broader distinctions of the main groups of plants and animals, the survey covers, with some detail, a few forms rather than imperfectly a large number of species. A large number of carefully selected slides are already available for histological purposes.

Prerequisite: Courses 1 and 2 of Department III.

Time: Class-room, one hour a week second semester.
Laboratory, three hours a week, second semester.

Text: Dodge, *Practical Biology*.

2. Paleontology.

A brief of view of the fossils is taken with special reference to the geological succession in Southwestern United States. Characteristic types of each of the geological periods are studied with care. The methods of determining geological horizons by means of fossils are discussed and allusion made to geological correlations.

Advanced study is offered to those desiring to take the subject as a main theme. The New Mexican field is very inviting. Details and time will be arranged.

Prerequisites: Course 1 of this department and Course 3 of Department VII.

Time: Class-room, two hours a week, one year.
Laboratory and field, three hours a week, one year.

Text: Zittel and Eastman, *Paleontology*.

3. Hygiene and First-Aid.

Lectures by local physicians on the laws of health and on the "first-aid" treatment of accidents. These lectures will be given at such times as will suit the convenience of the lecturers.

V. DEPARTMENT OF LANGUAGES.

EMMET ADDIS DRAKE, PROFESSOR.

A speaking knowledge of Spanish has recently become a great advantage, if not a necessity, to a large percentage of the young men who engaged in any of the lines of work for which they may fit themselves at the School of Mines. For that reason special attention is given to the study of the languages at this institution. The course offered continues thru two years and is designed to give the student a practical speaking knowledge of Spanish. The location of the New Mexico School of Mines affords an unsurpassed opportunity for acquiring this knowledge; for, in Socorro and vicinity, Spanish is as generally spoken as English.

Either French or German may be taken in place of Spanish if a sufficient number of students apply.

The courses in German continue thru two years. No particular attention is given to the speaking or writing of this language. The chief aim is to put the student into possession of a useful instrument for his major line of work.

The importance of a reading knowledge of both German and French cannot be emphasized too strongly, as a vast store of information necessary to the engineer and scientist is locked up in these languages. By the end of the second year the student should be able to read readily the scientific and technical books which are of use to him in his work.

The courses offered in French continue thru two years. The chief aim in this course, as in the course in German, is to give the student such a reading knowledge of the language as will be of practical use to him in the pursuit of his special line of work. At the end of the course, the student is expected to be able to read French with sufficient ease to use French text-books and other publications in the pursuit of his technical studies.

1. Spanish.

The work is based on Worman's First and Second Spanish Readers. A part of the class exercises each day consists in cross-translations, both oral and written. Special stress is placed upon conversational exercises. Attention is given to the elementary principles of the grammar of the language, especially to conjugation.

Time: Two and a half hours a week, one year.

Texts: Worman, *First* and *Second Spanish Readers.*
Garner, *Spanish Grammar.*

2. Spanish.

Alarcon's *El Capital Veneno*, and Valera's *El Pajaro Verde* are read. The study of Spanish grammar is pursued systematically, Garner's *Spanish Grammar.* being used as a text. Two periods each week are devoted to conversation in Spanish and to cross-translation, no particular text-book being used in this work.

Prerequisite: Course 1 of this department.

Time: Two and a half hours a week, one year.

3. German.

The first year's work in this course is elementary. It consists of study of grammar and easy readings. Practice in speaking and writing the language is not insisted upon any further than is needed in fixing the main principles of construction in the mind.

Time: Two and a half hours a week, one year.

4. German.

The second year's work in German consists in the reading of narrative and descriptive modern prose and a drama of Lessing or Schiller. The study of grammar is continued. Sight-reading forms a large part of the exercises of the second term. The reading texts are changed from year to year to avoid repetition and to give students who may desire an opportunity to take more than the required amount of German.

Time: Two and a half hours a week, one year.

5. **French.**

The first year's work is elementary. Otto's *French conversation Grammar* and *Le Roman d'un Jeune Homme Pauvre* form the basis of the work. The text-book for reading is changed from year to year, however, to give students who may wish it an opportunity to read more than the required amount toFrench. Easy readingsareassigned for work outside the class-room with a view to examination.

Time: Two and a half hours a week, one year.

6. **French.**

Effort is still concentrated upon reading. The student is expected to be able at the end of this course to read with sufficient ease to make practical use of French text-books and periodicals in his other studies. The study of grammar is continued. *La Petite Fadette*, *Le Cid*, *Le Misanthrope* and *Athalie* are the texts from which the readings are selected.

Time: Two and a half hours a week, one year.

VI. DEPARTMENT OF CIVIL ENGINEERING.

OLIVER RUSSELL SMITH, PROFESSOR.

In Civil Engineering, the first three years are devoted to the mastery of those sciences upon which all professional engineering practice is based. In addition to a thorough mathematical training, particular care is taken to familiarize the student with the construction, care and use of engineering instruments. To this end, in addition to the regular class-room work, much time is given to field work, wherein a great variety of practical problems are treated. Attention is also given to the study of engineering materials and their adaptation to various structures.

In the post-graduate work of the fourth year the student is offered several branches in which he may specialize. These are Structural Engineering, Sanitary Engineering, and Hydraulic and Irrigation Engineering. The work of this year is largely drawing and design, intended to prepare the student for practice along one of these lines.

The School offers great advantages in the line of Hydraulic and Irrigation Engineering. Besides being situated in a distinctly irrigation country, it is also in reasonable proximity to two of the largest projects of the United States Reclamation Service, where the latest and best methods may be studied.

In the summer field-excursions are worked out various problems which, because of their location and also from lack of time, could not be considered during the school year. Students have usually been able to attach themselves during the summer vacation to the regular surveying parties of railway, irrigation or mining companies, the United States Land Office or the United States Geological Survey.

1. General Surveying.

The introductory course in surveying deals with the principles of land-surveying, the instruments used both in the field and in the office, their adjustments and their proper

care. The transit, level, solar compass, and plane-table are discussed in detail and their uses in the various problems of land-, mine-, and hydrographic surveying are illustrated by numerous practical problems and field exercises.

In the field-practice, each student becomes thoroughly familiar with the laying out with compass and chain of small land holdings, the survey of urban lots and streets by means of transit and steel-tape, location of mining claims, and similar work. Observations are made on the polar-star for the purpose of determining the true meridan. Latitude, azimuth and time by direct solar observations are determined. Triangulation, both primary and secondary, from a measured base-line is carefully worked out. Measurements are made of mountain heights by triangulation methods. The various methods of topographic mapping are considered in detail. Prerequisites: Courses 1, 2 and 6 of Department I.

Time: Class-room, three hours a week, second semester.
Field, four hours a week, second semester.

Text: Johnson, *Theory and Practice of Surveying.*

2. **Plotting Surveys.**

Each student makes a complete map or plat of the surveys made during the progress of the summer field-work and of all the surveys made by him during the school year. Bearings or azimuths of courses are laid off both by protractor and by co-ordinates and errors in closure are discussed and illustrated. In general, areas are computed by latitudes and double meridian distances.

Prerequisities: Course 1 of this department.

Time: Laboratory, two hours a week, first semester.

3. **Free-Hand Drawing.**

It is expected that, during the first year, the student will acquire considerable skill in drawing, preparatory to the special training of later years. Particular attention is given to free-hand work in order to enable the student to make, readily and rapidly, intelligent sketches of all ordinary objects, simple machines, diagrams of engineering works and geological structures. A study of light and shade and of perspective is made, and pencil-and-pen drawings from

various models are executed, the proportions being obtained by making measurements of the object "pencil in hand."

Time: Three hours a week, half-hour periods, first semester.

4. Mine Surveying.

The work consists of lectures, field-practice and office-work. The field-practice embraces both surface location of claims and top-works, and the underground excavations.

In the location of mining claims, a complete survey is made for the purpose of patenting, in accordance with the requirements of the Surveyor General's Office. It includes all the methods followed by United States Mineral Surveyors. The law relating to surveys for the patenting of mining properties is treated in detail.

In the underground surveying, particular attention is given to physical difficulties met with and unusual obstacles to be overcome. Among the special topics that are dwelt upon at length are the location of underground stations, connection of surface and subterranean workings through slopes and shafts, graphic methods of keeping notes, preparation of mine-maps by method of co-ordinates, preservation of maps and permanent records.

In the field-practice, several mines of different types are surveyed, full notes taken and maps made. This work is supplemented by summer practice of still more extended character.

Prerequisite: Course 1 of this department.

Time: Class-room, two hours a week, first semester.
Field-practice and office-work, four hours a week, first semester.

Text: Johnson, *Theory and Practice of Surveying.*

5. Railway Surveying.

Under this head is studied the location of a railway under the three natural divisions of Reconnoissance, Preliminary Surveys, and Location Surveys, with the methods and instruments adapted to each. The theory of economy in grades and curves is considered at some length and the principles of simple and compound curves treated.

Practice is given in locating curves and tangents, levelling, plotting, establishing grades, constructing profiles, cross-sectioning, estimating volumes of fills and cuts, location of piers and bridge-abutments, and laying out of switches.

Prerequisite: Course 1 of this department.

Time: Class-room, three hours a week, second semester.
Field, six hours a week, second semester.

Texts: Johnson, *Theory and Practice of Surveying.*
Searle, *Field Engineering.*

6. Topographical Drawing.

The topographical survey made in the summer is plotted, all countour lines, streams, roads, fences and buildings being properly shown. The nature of the soil and vegetation is indicated by the conventional topographical symbols, thus making a complete and accurate map of the area surveyed. In plotting stadia work, special attention is given to rapid methods of reducing and plotting inclined stadia readings. The mechanical reproduction of maps to different scales and the evaluation of irregular areas are discussed.

Prerequisite: Course 1 of this department.

Time: Laboratory, two hours a week, second semester.

7. Roads and Pavements.

A brief discussion, from an engineering standpoint, of the principles involved in highway work under the following divisions: Ecodomic importance and characteristics of good highways, location, construction, drainage, improvement and maintenance of country roads, various paving materials, broken stone, brick, aspalt, wood and stone blocks, and concrete, foundations for and adaptability of each, arrangement and details of city streets.

Prerequisite: Course 1 of Department II.

Time: Class-room, two hours a week, second semester.

Text: Spalding, *Roads and Pavements.*

8. Masonry Construction.

The lectures treat chiefly of the following subjects:

(1) Materials used in masonry construction, under the heads of stone, brick, lime, cements, wood, iron and steel.

Special emphasis is placed upon the geological occurrences of the suitable materials and methods of testing.

(2) Foundations; open trenches, pile foundations, foundations under water, cofferdams, cribs, pneumatic and other methods.

(3) Dams; brush-cribs, framed timbers, masonry and rock fills.

(4) Retaining wall, bridge abutments and bridge piers.

(5) Culverts, wood, pipe and stone arches.

Prerequisite: Course 1 of Department II.

Time: Class-room, three hours a week, second semester.

Text: Balser, *Treatise on Masonry Construction.*

9. Sanitary Engineering.

An elementary course in sanitary science dealing with the drainage of building and lands, disposal of house sewage, water carriage systems, storm sewers; also the heating, plumbing and ventilation of buildings both public and private.

Prerequisites: Courses 1 and 8 of Department II.

Time: Class-room, two hours a week, first semester.

Text: Merriman, *Sanitary Engineering.*

10. Railway Location.

This course presents the economic phases of railway location and construction. The causes which affect the gross receipts of a road, the cost of construction and the operating expenses are fully discussed, and the relative importance of each considered in detail. True and false economy in construction, and kindred topics are entered into at length.

Prerequisite; Course 1 of Department II.

Time: Class-room, three hours a week, second semester.

Text: Wellington, *Economic Theory of Railway Location.*

11. Stresses in Frame Structures.

The application of the laws of forces in equilibrium to the computation of the stresses in various kinds of frame structures; the method of moments; the method of resolution of forces; loads on a roof truss; dead-, snow- and wind loads; changes in length due to changes in the temperature; highway bridges, dead loads, moving loads, snow and wind; applications to different forms of truss; railway bridges, dead

loads, moving loads; snow, wind and impact; shear and bending moment; double and multiple truss systems; deflection of bridges. Numerous practical problems are presented for solution.

Prerequisite; Course 3 of Department II.

Time: Class-room, three hour a week, second semester.

Text: Merriman and Jacoby, *Roofs and bridges*, *Part I.*

12. **Graphical Statics.**

In this course the graphical methods of solving problems relating to forces in equilibrium are considered in detail. These methods are based upon the representation of forces in amount and direction by straight lines, the properties of force-polygons and equilibrium-polygons, moment and shear diagrams. Special attention is given to the application of these methods to the stresses in various framed structures.

Prerequisite: Course 1 of Department II.

Time: Class-room, three hours a week, second semester.
Laboratory, five hours a week, second semester.

Text: Merriman and Jacoby, *Roofs and Bridges*, *Part II.*

13. **Structural Details, A.**

Practical applications of the principles of stresses in the design and proportioning of the various parts of engineering structures, dams, arches, roofs, and bridges.

Special attention is given to designing long columns and to the connections of the members of a structure.

Prerequisites: Courses 11 and 12 of this department.

Time: Class-room, two hours a week, one year.
Laboratory, six hours a week, one year.

Text: Merriman and Jacoby, *Roofs and Bridges*, *Part III.*

14. **Structural Details, B.**

More advanced work in continuation of Structural Details A. in which are considered steel mill and office buildings, cantilever and draw bridges, steel arch ribs and concrete arches.

Prerequisite: Course 13 of this department.

Time: Class-room, two hours a week, one year.
Laboratory, nine hours a week, one year.

Text: Merriman and Jacoby, *Roofs and Bridges*, *Parts III and IV.*

15. Concrete Structures.

This course deals with the designing and construction of reinforced concrete structures, the materials used and the methods employed; the properties of concrete and steel, practical formulas for the computation of all classes of structures, illustrations and descriptions of a large number of representative structures, properties of and methods of testing the materials used, various types of reinforcement, forms, facing and finishing.

Prerequisites: Courses 1 and 5 of Department II.
Time: Class-room, five hours a week, first semester.
Text: Buel and Hill, *Reinforced Concrete.*

16. Contracts and Specifications.

Lectures on the laws governing contracts and their special applications to engineering construction; approved forms of specifications for various structures.

Time: Class-room, two hours a week, first semester.
Text: Wait, *Law of Contracts.*
Various standard specifications for reference.

17. Water Supply.

The design, construction and maintenance of municipal water supply systems, under the following divisions; sources and requisites of water supply, methods of collecting, storage and distributing water; the flow of water in various kinds of conduits, storage reservoirs, analysis and purification of public water supplies, pumping systems, maintenance of quantity and quality of supply, maintenance of storage and distribution works, house connections, meters and waste of water.

Prerequisite: Course 8 of Department II.
Time: Class-room, three hours a week, second semester.
Text: Folwell, *Water-Supply Engineering.*

18. Sewerage and Drainage.

A study of the quantity of house sewage and storm waters, the proper shape and dimensions of conduits for water carriage systems; sewer ventilation and flushing, office of man-holes, flush tanks and other details of construction; loca-

tion of outfall, final disposal of sewage, sewage irrigation, filtration, septic treatment, cremation of refuse.

Prerequisite: Course 8 of Department II.
Time: Class-room, three hours a week, first semester.
Text: Folwell, *Sewerage.*

19. **Irrigation Engineering.**

The condition governing, and the extent and commercial value of the irrigation of arid lands in this and other countries, sources and requisites of a supply of water for irrigation, difficulties and harmful effects of irrigation, flow and measurement of water, duty of water, storage, distribution and application of water, together with a brief description of the structures appropriate to each division of the process.

Prerequisite: Course 8 of Department II.
Time: Class-room, three hours a week, first semester.
Text: Wilson, *Manual of Irrigation.*

20. **Hydraulic and Masonry Design.**

This course is chiefly field and drawing-room work in the preparation of plans and specifications for a municipal water supply, a sewer system or an irrigation system, at the option of the student, the data on which to base the design being collected by the student himself.

Prerequisite: Courses 17, or 18, or 19 and 21 of this department should precede or accompany this course.
Time: Class room, one hour a week, one year.
Laboratory and field, six hours a week, one year.

21. **Irrigation Structures.**

A detailed study of the various classes of structures necessary for the impounding, distribution and application of water for irrigation purposes, with descriptions of numerous examples of the various types of dam used (especially those used in American practice), masonry, rock and earth fills and timber cribs, storage capacity and sedimentation of reservoirs, waste-ways, diversion weirs and head works, distribution systems, canals, lined and unlined, tunnels, flumes and aqueducts, water power in connection with irrigation systems.

Prerequisite. Course 19 of this department.
Time: Class-room, two hours a week, second semester.
Texts: Schuyler, *Reservoirs for Irrigation.*
Flynn, *Irrigation Canals and other Irrigation Works.*

22. **Summer Field-Work.**

During the summer surveying parties are organized, comprising all undergraduate students and others, for a period of about four weeks. The field practice is continuous in the various branches of surveying. These parties camp in localities convenient to their respective lines of work.

The first-year men are assigned a township of land which they subdivide in accordance with the instructions of the United States Land Office, and make a topographical map by the transit and stadia and plane-table methods. Of the upper-class men the students of Mining Engineering make complete surveys and construct maps of important mines; while the Civil Engineering students locate a railway from five to ten miles in length, according to conditions, and also make complete surveys, maps and estimates for an irrigation system.

Each year students are usually able to secure employment for the summer with regular surveying parties and receive encouragement in this in every way possible.

23. **Journal Club.**

A fortnightly gathering of engineering instructors and students, at which current literature is read and discussed.

VII. DEPARTMENT OF MINING GEOLOGY.

CLINTON J. SARLE, PROFESSOR.

The organization of this department, having for its special purpose instruction concerning ore-bodies and their relations to geological structures, is founded on the belief that the proper knowledge of this branch of mining contributes equally as much to the success of any enterprise as a knowledge of mechanical mining methods, or what is most generally understood by mining engineering. The proper geological consideration of the materials sought after in mining, vastly promotes mining both generally and specifically by putting each proposition upon a more strictly business basis. Prospecting is more rationally conducted. Exploration is more confidently carried on. Exploitation is systematically productive. The element of chance is very largely eliminated.

For the most part, the work in these courses is laid out with reference to the mining aspects of the subject. Great importance is attached to field-work and, for this work, the facilities offered by the neighborhood are nowhere else surpassed.

1. Descriptive Mineralogy.

(a.) Crystallography. This particular division of physical mineralogy, dealing with the geometrical forms in which mineral crystallize, is thoroughly studied. The different crystal systems are considered in turn and constant practice in the reading of crystal forms is given by means of a complete collection of wooden and celluloid models and also from specially selected natural crystals. The subjects of twinning, hemihedrism, tetartohedrism, hemomorphism, and like topics are studied in detail.

In the laboratory, the projection of crystal forms is carried on and clinographic projection made of the principal types in the several systems. In addition to this, zone-control and the determination of the indices of unknown planes lying in

two or more zones are explained and problems assigned. Exercises in orthographic, clinographic and spherical projections form an essential part of the laboratory work.

Frequent reference is made to Dana, Nuaman and Miller, and the symbols used by each are mastered.

Prerequisites: Courses 3 and 4 of Department I.

Time: Class-room, three hours a week, first twelve weeks of first semester.

Laboratory, three hours a week, twelve weeks.

Text: Williams, *Elements of Crystallography.*

Miers, *Mineralogy.*

(b.) Physical Mineralogy. The subjects of hardness, cleavage, color, specific gravity, etching and thermo-electric properties, optical characters and the like are carefully considered. The special study of optical properties and of the actions of crystals on transmitted light is deferred, however, until petrography is studied.

Prerequisite: Course 1 (a) of this department.

Time: Class-room, three hours a week, last five weeks of first semester.

Laboratory, three hours a week, last five weeks of first semester.

2. Determinative Mineralogy.

Specimens of minerals from the large collections of the School and also those collected on field excursions or sent into the laboratory are examined and identified by the student, the crystal form, the physical and chemical properties and the paragenesis of each mineral being carefully studied. Special emphasis is given to acquiring familiarity with a large number of such mineral species as occur in mining regions and with the associations in which they are likely to be found. The order of study followed in the lectures is; the elements, sulphids, selenids, arsenids, tellurids, antimonids, sulphosalts, haloids, oxids, oxygen-salts, salts of the organic acids and hydrocarbons. Much of historic interest is given in the lectures, and gems and precious stones receive considerable attention. Collateral reading is required on the important species.

Weekly quizzes, monthly reviews and other practical exer-

cises supplement the daily lectures and serve to broaden the student's training, as well as to fix in his memory the various distinctions between mineral species. The relative values of each mineral, both from the standpoint of economic use and its worth for mineral collections, are clearly and fully set forth.

Prerequisites: Course 1 of this department and Courses 1 and 2 of Department III.

Time: Class-room, two hours a week, second semester.
Laboratory, three hours a week, second semester.

Texts: Dana, *Systems of Mineralogy.*
Miers, *Mineralogy.*
Moses and Parsons, *Mineralogy, Crystallography and Blowpipe Analysis.*

3. Principles of Geology.

All of the training in geology is arranged with special reference to professional work. There are three main classes of students to which the courses have been particularly adapted. The first class embraces those whose occupations are to be closely indentified with mining. A second class includes those who look forward to employment of a more or less public character, such as is afforded by private, State and Federal geological surveys. A third class aims to embrace students who expect to follow, in part at least, the pure science of geology, or to be connected with the economic and technical departments of higher educational institutions.

The instruction is conducted by means of lectures, recitations, laboratory examinations and frequent excursions into the field and is designed to familiarize the student with the data of geology. Materials composing the earth, the soils, rocks, minerals, ores, fossils and earth-forms, receive the attention they deserve as fundamental elements. The processes and conditions of geology are considered in their different aspects. The laws and methods of interpretation of phenomena are discussed with considerable detail. The mental operation of observation, generalization, suggestion of hypothesis, formulation of theory and proof of geological doctrine are explained and the importance of properly considering them in all scientific work is emphasized.

Features illustrating a large variety of geological phenomena are well displayed in the neighborhood of the School and afford excellent opportunities for field-work. The old Socorro volcano, rising 2,500 feet above the campus, presents many types of rocks, and many structures associated with volcanic districts. Lemitar mountain, six miles away, affords other phenomena of vulcanism. Faulting, folding, jointing and other associated features, are well displayed. The sedimentaries are well represented from the paleozoics to the most recent. The phenomena of erosion, and the development of geograpic forms are almost unique. With all these illustrations at the very door of the School the student is never at a loss for someting interesting and new.

Excnrsions are made, mines are visited and the students is instructed in the art of taking notes, and of making sketches and maps. Hə subsequently writes out a full, but concise report of his observations, which is critically examined in all its aspects by the instructor in charge. These reports are then talked over in class, and the shortcomings noted and corrected.

An outline of the course is furnished by syllabus, with frequent reference to the principal text-books on geology.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room three hours a week, one year.
Field, three hours a week, one year.

4. Economic Geology, A.

The subject is taken up according to the different metals commonly mined. The principal deposits of this country are discussed in all their different aspects and the uses of each, their geological peculiarities; and the special methods of working each are considered. The leading foreign occurrences are also taken up.

A syllabus is followed in the general treatment, Constant reference is made to Kemp's "Ore Deposits of the United States and Canada," Tarr's "Economic Geology of the United States," Fuchs and DeLauneys's "Traite des Gites Mineraux et Metalliferes," Von Cotta's "Die Lehre von den Erxlagerstaetten, Frequent references to original sources of information are also made.

The various iron ores are first taken up. These are followed by a consideration of the ores of lead, zinc, silver, gold and then the rarer and less important metals. The different combinations of these several ores are also described. The relations of the ore-bodies to the geological formations and structures are especially emphasized.

Prerequisite: Course 3 of this department must precede or accompany.

Time: Class-room, two hours a week, first semester.

5. **Economic Geology, B.**

The subject is treated with much greater fullness than is usually apportioned to it in the works on economic geology. A syllabus is used, supplemented by copious references to the original sources of information, and instruction is given with special reference to the engineering aspects of the materials, the uses and the methods of mining and preparing the raw substances for the market.

The fuels are considered with special reference to their value as steam producers, their manner of occurrence and the geological structures determining their accessibility.

The building stones are not only treated with regard to their physical and chemical properties, but special attention is paid to their microscopical characters. The intrinsic qualities and external conditions affecting the durability of stones used in engineering constructions are gone into in detail. The comparative durability of different kinds of stones is considered both by means of tables and by systematic testing. The means of artificially preserving building stones are described. Methods of quarrying and the use of machinery in quarrying all come in for adequate treatment.

Cement materials, limes and gypsum are especially considered, together with the means adopted for testing them.

Soils, fertilizers and road metals are described as to their geological occurrence and their properties.

Each of the minor mineral substances used in construction or in the arts is given the consideration it deserves.

Prerequisite: Course 3 of this department must precede or accompany.

Time: Class-room, two hours a week, second semester.

6. Dynamical Geology.

A detailed consideration of the dynamic agencies involved in the geotectonic and geographic evolution is given. The general scheme followed is genetic in character, as given in Keyes' "Genetic Classification of Geological Phenomena." The fundamental principle recognized is that the processes and not the products are made the central theme. There is thus always presented the underlying relationship of cause and effect. All products find accurate expression in terms of the agencies.

The agencies affecting rock-masses as a whole are discussed in all their various aspects. Models, photographs, other illustrations, and examinations in the field, all contribute to an understanding of the various phenomena commonly met with. Subterranean waters, the conditions governing their movements, and the capacities for transporting metallic substances in solution are treated in considerable detail. The causes of formation and the phenomena presented by mineral-veins and ore-bodies are given particular attention.

Volcanic activity and the influence of such conditions upon the rocks which come in contact with intruded masses of molten rock are fully described and copiously illustrated by examples drawn from New Mexican localities, and from other easily accessible localities. New Mexico is very rich in phenomena of this kind and the field is practically a virgin one.

Prerequisite: Course 3 of this department.

Time: Class-room, three hours a week, first semester.
Field, four hours a week, first semester.

7. Structural Geology.

Thoughout the entire course, the mining aspects of the subject are kept constantly in the foreground. The intimate relationships which the structures exhibited by rock-masses bear to the economic deposits associated are especially emphasized.

The simpler phenomena of stratification are fully explained and illustrated. The various processes involved in the formation of sedimentary rocks and the conditions under which the latter are deposited are described more in detail than was

possible under Dynamic Geology. Sedimentation itself is followed in all the various phases of transportation and deposition of land-waste. Discussion of the factors which should guide the interpretation of the sedimentary record, forms an important part of the course.

Joint-planes, tilting of strata, the folding, crumbling and crushing of rock-masses are amply illustrated from New Mexican sources. Cleavage, faulting and the relationships of eruptives are explained. Dikes and mineral-veins are especially dwelt upon.

Collateral reading and interpretation of geological maps constitute an integral of the work.

Prerequisites: Courses 3 and 6 of this department.

Time: Class-room, three hours a week, second semester.
Field, four hours a week, second semester.

8. Stratigraphical Geology.

The main purpose of the course is to enable the student to get a connected idea of the history of the earth. The biotic features of the various periods are illustrated by the most important type-forms of life. Practice in determining fossils and in interpreting their character is designed to familiarize the student with the common principles of stratigraphy.

The economic value of fossils is commonly entirely overlooked. Often even a slight acquaintance with the true character of fossils enables the rocks to be read as a printed page. It is one of the best established facts in modern geological science that there is an intimate relation existing between mineral deposits and the surrounding rocks; hence the geological age of the particular beds becomes an important factor in the early attempts to develop new mineral districts. This suggestion again rests upon one of the cardinal principles of geology; that the geological succession of strata is determinable readily by the remains of life contained. Thus, is reality, fossils are labels on the rocks, telling one at a glance the age of the bed that he is working, and providing him with the most reliable guides he could possibly secure to direct him to the layers most likely to contain the mineral sought.

The range and geographic distribution of the geologica formations are discussed, and their important local facies

described. Their characteristic features in the Rocky Mountain region are dwelt upon in considerable detail. Maps, charts, models, and other illustrative materials are critically examined. The construction of geological sections is explained. Actual work along this line is undertaken under the supervision of instructors.

Prerequisites: Courses 3 and 6 of this department.

Time: Class-room, three hours a week, second semester.
Field, simultaneous with preceding course.

9. **Practical Geology.**

This course is intended to give a working knowledge of the actual field methods in geological inquiry. There are taken up some of the leading criteria of geological discrimination, the foundations of classification and the manner of working towards the attainment of tangible and definite ends.

The collection of material and apparatus is only incidentally touched upon. The methods of work in the indoor laboratory are passed by altogether.

The practical analysis of geological phenomena is viewed from the standpoint of the geological survey. This, in its modern development, embodies the most exact adjustment possible of actual field-work, laboratory examination and comprehensive deduction. Each problem is attacked from a number of different view-points; separate lines of investigation are focussed upon every question.

Special stress is placed upon those particular phases of practical field-work in geology which experience and consultation have oftenest shown are those to which greater attention should be paid than is usually the case. They are phases ln which nearly all persons entering the field of independent geological inquiry have to be instructed before they are able to accomplish the tasks demanded of them.

Among the various themes discussed are the equipment for field-work, the methods of geological mapping, the determination of rocks and rock-masses, the attitude of rock-masses, the deciphering of original geological structures, the dissection of acquired geological structures, geological classification, investigation of massive crystalline masses, crystalline

schists, and the sedimentaries, and the application of geological principles to the exploitation of mineral deposits.

Prerequisites: Courses 1, 2 and 3 of this department.

Time: Class-room, one hour a week, first semester.

10. **Topographical Mapping.**

A course in topographical mapping in accordance with the methods followed by the governmental bureaus of all civilized nations. The methods of the United States Geological Survey in particular are fully considered and ample field practice afforded. The relations of geologic structure to topograpic expression are discussed, numerous practical illustrations explained and examined on the ground. All factors entering into the preparation of an adequate topographic base for exact geologic mapping of rock-masses and the proper representation of geologic structures are viewed in their different aspects and the construction of a suitable topographic base-map is carried out in a practical way. The various methods are considered in detail and the advantages and shortcomings of each under different conditions are discussed and compared. Practice in primary triangulation and secondary triangulation and the filling in of the larger traingles by plane-table methods is made a feature. In putting in the topography the contour method is chiefly adopted, and particular attention given to the morphogenic expression of earth-sculpture.

Students may select prescribed areas of 25 square miles each in which there is a great diversity of surface-relief and geologic formations and will be given every opportunity to perform all the work with proper supervision, as a part of a comprehensive scheme for mapping the region which the School has begun. For this work credit is given both on the published map and in the accompanying printed reports.

Prerequisite: Course 3 of this department and Course 1 of Department VI.

Time: Field and laboratory, six hours a week, first semester.

11. **Geological Surveying, A.**

The methods are those followed by the National and State Geological Surveys, and the work is especially adapted to

those students who are looking forward to investigations of a public character.

Part of the training in geological surveying is obtained in pursuance of the more advanced courses in geology and in the study of mineral deposits. In these courses, it is expected that the student will have acquired something of the art of making topographic base-maps in which the local facial expression of the earth is recognized as due to the underlying rock-structure, of sketching in the formations and of intelligently constructing geologic cross-sections.

The work is taken up in a thoroly practical way, the chief aim being the preparation of a way for intelligent guidance in the search for mineral wealth.

Prerequisites: Courses 1, 2, 3 and 10 of this department.

Time; Class-room, one hour a week, second semester.
Field, six hours a week, second semester.

12. Geological Surveying, B.

A continuation of the preceding course.

Prerequisite: Course 11 of this department.

13. Petrography.

As introductory to this course, optical mineralogy is first studied, particular attention being given to the subject of polarization, optical constants and the effects produced by thin sections of various minerals between Nicol prisms both in parallel and in converged light.

The principles thus studied and the differences observed are then used by the student to extend his acquaintance with the various types of rock in the form of mineral aggregates as well as in the form of individual crystals. The appearance which the igneous rocks present when viewed in thin sections under the microscope are thoroly considered. The lectures take up the simpler granites and, in order, the rest of the acidic series, then the members of the intermediate series, the basic series and finally the small group of the ultra-basics. With the last mentioned series, the celestial rock-types are briefly treated.

Particular attention is paid to the alteration of minerals in rocks, as disclosed by the microscope, for the reason that the

subject has such an important bearing upon rock metamorphism in general and the formation of ore-bodies in particular.

The subject of the separation of rock constituents by means of heavy solutions and the microchemical reactions are entered into with considerable detail.

Each student is required to identify a number of samples of rock by preparing thin sections from them and subjecting these sections to microscopical examination.

Prerequisites: Courses 1 and 2 of this department and Course 2 of Department II.

Time: Class-room, three hours a week, one year.
Laboratory, six hours a week, one year.

Text: Rosenbusch *Mikroskopische Physiographie der petrographisch wichtigen Mineralie.* (translated by Iddings.)

14. **Ore-Deposits.**

(a) Genesis of Ore-Deposits.

The instruction in this subject is essentially in the principles of ore deposition.

The subject is treated by lectures, supplemented by copious references to the literature. Numerous field inspections are necessary and it is advised that this branch of the work be made as extensive as possible. In addition to the regular class excursions, which take place on Saturdays and in vacation times, individual inspections are recommended. An important part of this work will be succinctly written reports of what has been seen.

Among the main general topics treated of in the lectures are: The distinguishing characters of ores, an outline of the geological terranes, the geological structures especially connected with ores, the geology of ore deposits (as space fillers or geological formations), the conditions governing ore deposition, the character of ores, the mineralogy of ores, the structural features of ore bodies, rock alteration and its relation to ore formation, and the classification of ore-deposits.

No text-book is used. The outline of the course is obtained from the syllabus. The leading treatises on the subject of ore-deposits are constantly consulted. The aim of the course

is to give a concise and philosophical view of the foundation of ore exploitation, and modern mining. A number of specific cases out of the total number met with by the student in the course of his inspections are critically tested by the several general theories of ore deposition.

Prerequisites: Courses 4 and 5 of this department must precede, Courses 1 and 2 of Department VIII must precede or accompany.

Time: Class-room, four hours a week, first half of first semester.
Field, three hours a week, first half of first semester.

(b) Type of Ore-Deposits.

In accordance with the scheme of classification adopted the main types of ore-deposits are discussed in all their aspects, and illustrations of each given. The subject is approached from the geological view point. The general plan followed is essentially an arrangement of the geological processes, so far as they affect specifically the ore bodies and their original deposition. The resulting ore classification itself is in terms of the forms of ore-bodies as geological formations or terranes, and as dependent upon geological structures. This basis appears to be the only one that is truly genetic in nature, and yet serviceable in ore exploration.

The data for an ore classification of this kind are derived largely from the facts and principles established in the course of the great advancements recently made in the study of crystalline schists and metamorphic rocks in general, as the result of the applications of the microscope.

It is therefore quite essential that something of the principles and method of microscopical petrography should have been acquired before the subject can be fully appreciated.

The fundamental thought running through the entire course is that the main thing to be sought for in the classification of the ore bodies is a system that is based upon genesis so far as possible, that is practical in application and that will aid in their discovery and development. It is assumed that each a scheme should be made so that the ordinary miner may use it. At the same time, it should not offend the most rigid theorist. This common ground seems to be found by giv-

ing due consideration to certain geological principles which have recently been found to have a special bearing upon the deposition of ores themselves.

Comparisons are made between the principal classificatory schemes, including those of Von Oppel, Werner, Von Cotta, Whitney, Phillips, Von Groeddeck, Posepny and others.

During the various excursions to settled mines, opportunity is given students to examine the ore bodies and to discuss and determine, each for himself, the method of formation and the type to which each ore-body belongs. This being accomplished, the best method of exploitation and the probable extent are considered. The secondary changes which the original ore-body has undergone are also studied.

Prerequisites; Same as for 14 (a) of this department.

Time: Class-room, four hours a week, second half of first semester.
Field, three hours a week, second half of first semester.

Text: Keyes, *Origin and Classification of Ore-Deposits.*

15. **Special Problems.**

It is expected that the student has already become more or less familiar with the various districts in the neighborhood of the School. He is encouraged to take up the exhaustive study of some limited area, in conjunction with, or under the guidance of his instructor, or he is given some area or theme that has already been well worked out and the results published, and he is required to repeat the investigation on his own account. There is a wide range of topics from which to select. Nearly all departments of geology offer problems that are both varied and highly instructive.

In connection with the systematic geological work of the New Mexican region the broader problems are continaully growing upon the student and some of these become available for extended and exhaustive original inquiry.

Prerequisites: Courses 4 and 5 of this department, and Course 1 of Department VI.

Time: Field or laboratory, twelve hours a week, second semester.

26. Methods of Geological Correlation.

The modern conceptions of geological formations or terranes and the means of recognizing them in regions more or less remotely separated geographically are reviewed in considerable detail. Illustrations are drawn from nearby sources whenever possible. Comparative values of the different correlation methods are considered under diverse conditions. Adoption of different and perfectly independent methods in general correlative work is urged, Any given method may have quite different values in different localities. Marked discrepancies when one method alone is applied may be checked by the readings of other records.

Concrete examples are cited in which the various methods of correlative criteria have been applied and their practical values in field work determined. Correlation by means of similarity of lithologic sequence, by lithologic similarity, by faunal comparison, by orotaxis and by homogeny come in for special mention and discussion.

17. History of Opinion on Ore Deposition.

Near the close of the fourth year, a short series of lectures is given in which the various views that have been held in regard to the formation of ore-bodies are set forth in detail, and compared. Their influence upon mining and upon scientific thought is dwelt upon at some length. These lectures will be given weekly for eight weeks.

18. Principles of Ore Deposition.

During the last term of the fourth year the preceding course is followed by a number of weekly lectures on the general principles governing the formation of ore-bodies.

19. Geological Philosophy.

The great unsolved problems with which geologists today are wrestling are reviewed and discussed in all their various phases. The rise and growth of the ideas, the names of the men associated, and the present trend of thought upon these subjects are considered. References are made to the best literature on the various aspect of the different topics. The present tendencies of geologic work are concisely summed up.

20. History of Geology.

A connected account is given of the origin and devolopment of modern geological thought, and the influences which have contributed to the evolution of the present tenets of the science.

It is expected that the student will supplement the lectures in this course, largely biographical in treatment, by careful perusal of the literature bearing upon the subject. The main aim of the course is to acquaint the student with the men who made of earth-study a science, with their personalities, their environments, the conditions under which they worked and the difficulties which they encountered.

21. Research Work.

It is a recognized tenet of the institution that the greatest benefits are not secured to the student until his training has been such as to enable him to conduct independent investigation. During the period of preparation previous to the time when independent inquiry is taken up with profit many problems will have suggested themselves for solution. If, however, the student has been unable to make any selection of topic for himself a suitable problem will be assigned to him.

The opportunities and facilities for research work in nearly all branches of geology are practically so unlimited and the entire field is such a virgin one that it is doubtful whether any other region in the whole country is so inviting as that of New Mexico.

For the study of mountain structure no region surpasses southwestern United States. The effects of vast erosion, the dry climate, the prodigious faulting and tilting of orthographic blocks, all contribute to expose the stratigraphy and structure on a scale not to be comprehended elsewhere on the continent.

Many of the broader philosophical questions which now hold the attention of geologists the world over find ample illustration in New Mexico. Mountain building, epeirogenic movements, isostatic adjustment, vulcanism, land-sculpture and extensive sedimentation far removed from the sea, find innumerable phases awaiting careful study.

Mineralogy, petrography, ore-genisis and paleontology also offer new fields for profitable research.

22. Thesis.

Those students electing the general course in Mining Geology are expected to defend creditably the conclusions drawn from some more or less extended investigation. The theme may be in the nature of an extension of work already begun the previous years, a special phase suggested during the preliminary researches, or on some entirely new subject, selected by the candidate for a degree, or by his instructor. Besides being distinctly a contribution to knowledge, the thesis must show ample evidence of a wide acquaintance with the literature directly bearing upon the theme.

It is expected that the student during the last year of his course will devote at least one third of his time to the preparation of his thesis. The subject of the thesis must be announced at least one year prior to the time when the student intends to come up for his degree, and be approved by the instructor under whose supervision the work is undertaken. If accepted, the thesis is required to be printed in standard form, or, if in part, to the extent of at least 20 pages, and 150 copies presented to the School.

VIII. DEPARTMENT OF MINING ENGINEERING.

REINOLD V. SMITH, PROFESSOR.

The instruction in mining is given by means of lectures illustrated by photographs and detailed drawings, and by field examinations. The latter enter largely into the more practical part of the work. Mine administration and mining law receive complete treatment. The entire course is pre-eminently practical in character, and articulates closely with both the courses in mining engineering and mining geology.

As one of the chief purposes of the School is to prepare men to be planners of mines and supervisors of mining operations, the strictly business character of the profession is kept constantly before the student. Valuing property, properly reporting propositions submitted for investment, calculating in a careful manner all the factors in the economical operation of a plant, suggesting the best methods of developing a property, are considerations which require many trials before perfectly satisfactory results are secured. This effort is given prominence.

Another important feature which is continually being more and more considered in mining operations is the geology of the mineral deposits, and this subject receives greater attention than usual.

1. Mining Methods, A.

The following subjects are studied:

Mineral deposits, their classification from a mining standpoint and their irregularities as affecting the work of exploration and mining.

Examination of mineral properties; relation of topography to geological structure; tracing of probable outcrops.

Prospecting by ditches, pits and deep borings.

Development; choice of methods; location of openings.

Excavation of earth: tools; methods; supports.

Excavation of rock: explosives, kinds, nature, manufacture and use; methods of drilling and blasting, mammoth blasts, submarine blasting; quarrying.

Tunnelling: methods of driving and timbering; submarine tunnels; permanent linings; sizes, speeds of advance and costs.

Boring: methods and appliances for small depths and for deep boring; the diamond drill; survey of bore holes.

Shaft-sinking: methods and tools for both hard and soft material; sinking lining; handling and hoisting of material; timbering, walling and tubing.

Surface workings and hydraulic mining.

Prerequisites: Courses 5, 6 and 7 of Department I, Courses 1, 2, 6 and 7 of Department II and Courses 1 and 2 of Department III.

Time: Class-room, five hours a week, first semester.

Texts: Foster, *Ore and Stone Mining.*
Ihlseng, *Manual of Mining.*

2. **Mining Methods, B.**

The subjects studied are:

Surface-handling and transportation; arrangements for loading, unloading and storage of minerals; mineral railroads and common roads.

Water supply.

Drainage: sources, control and raising of mine waters; dams; drainage-levels.

Ventilation: requirements for pure air; vitiation and purification of mine-air; methods of ventilation; measurement and control of air-currents.

Illumination: candles; torches; lamps classified as oil, gasoline, magnesium, acetylene, electric and safety.

Accidents to men from fire-damp, dust explosions, mine-fires, falling material and inundations; prevention; rescue and relief.

Prerequisites: Same as for preceding course.

Time: Class-room, three hours a week, second semester.

Texts: Same as in Course 1.

3. **Examination of Mining Methods.**

By inspection of mining methods followed in the various camps in the neighborhood of the School there is afforded

great variety of illustration of the themes developed in the lectures.

The inspections are carried on partly as class-work in company with the instructor in charge, and partly as individual work. Full notes are required to be taken and these are subsequently reduced in the office to proper form, accompanied by the necessary sketches and plans to make the whole procedure thoroughly intelligible.

Prerequisites: Courses 1 and 2 of this department,

Time: Field, five hours a week, one semester.

4. Examination of Mines.

The main object sought in this course is to train the student sufficiently in expert mine examination work to enable him to report intelligently upon a mining proposition as to the advisability of purchase, or of operation.

Practice is afforded in making regular reports, complete in every respect, on different kinds of mining properties. Each student is assigned a different mine or property to examine. In case the mine has been reported upon in previous years detailed comparison of the results is afterwards made.

Among the more important topics usually considered are the topography of the district, as an index to its accessibility, and outside constructions, the character of the geological formations, the geological structure (particularly as affecting the ore bodies,) the character and disposition of the ores, the amount of ore in sight the probable extent of the unexplored part, the best method of extracting the ore, of concentrating it, of preparing it for shipment or treating it immediately for the metal, the water facilities and the facilities for transportation to market. Full computations are required, and estimates of the cost of each process, and of the necessary plant, and each of the various parts.

Prerequisites: Courses 1 and 2 of this department and Course 3 of Department VII.

Time: Field, ten hours a week, first semester.

5. Ore Dressing.

An advanced course, the elements having been taken in General Metallurgy. In it is comprised a detailed study of severing by means of breakers, rolls, stamps and fine grind-

ing machines; the sizing and classification of pulps by mechanical, pneumatic, and hydraulic processes; the principles and importance of sizing and classifying; the separation and concentration by hydraulic and electrical methods and also by means of oil and acid flotation.

Prerequisites: Course 8 of Department I, and Courses 1, 6 and 8 of Department II.

Time: Class room, three hours a week, second semester.

Text: Richards, *Ore Dressing and Concentration.*

6. Mine Plant.

The following machinery and appliances are studied and critically discussed.

Hoisting: engines, drums, wire rope, skips and cages, headframes; calculation of power required and methods of equalizing the load on the engine; devices for prevention of overwinding; shaft-sinking plant.

Drainage: buckets, tanks and head-pumps; Cornish and direct-acting underground pumps: operation of pumps by electricity, compressed air and hydraulic power.

Ventilation: natural ventilation, underground furnaces, positive blowers and centrifugal fans; efficiences of fans.

Air-compressors; straight-line and duplex; simple and compound compression; heat of compression; conveyance of compressed air; efficiencies.

Machine drills: construction and operation.

Underground haulage: mine cars; arrangement of tracks; hand tramming; mule and rope haulage; gravity roads; steam, compressed air and electric locomotives; comparative efficiencies.

Prerequisites: Courses 3 and 4 of this department.

Time: Class-room, three hours a week, one year.

7. Mine-Plant Design.

As in the designing of a metallurgical plant, the student takes up a given mine, makes all the proper surveys, plans the top-works, makes full work-drawings of all buildings, trams, ore-bins and similar constructions, and draws up detailed specifications, bills of materials and full estimates of cost.

If an operating mine happens to be selected for this, the entire work is examined, improvement incorporated, and suggestions made where saving may be made. This work, when further elaborated, will be accepted as a thesis.

Time: Laboratory, six hours a week, one year.

8. **Mine Administration and Accounts.**

In all the transactions of the mining courses, particular stress is laid on the business aspects of mining operations. The value of keeping tabulated records of different grades of work, and its cost from day to day, is urged as a means of constantly reducing the fixed charges and of doing away with much of the extraordinary expenditures, without reducing the efficiency of the work. The devising of methods of increasing the output, with limited working forces, is emphasized.

Not only are the subjects of labor in all its various phases, the details of supplies, and the sale of ore prepared for market taken up, but mine accounts, statements of cost and monthly reports are discussed.

Time: Class-room, two hours a week, first semester.

9. **Mining Law.**

A short course of lectures on mining law, particularly in relation to the manner of locating placer, lode and tunnel claims, on water rights, law of the apex and similar questions.

Time: Class-room, one hour a week for eight weeks, first semester.

IX. DEPARTMENT OF METALLURGICAL ENGINEERING.

REINOLD V. SMITH, PROFESSOR.

The Metallurgical Department aims to turn out its graduates equipped with the knowledge necessary to the successful management of metallurgical plants, and to take full charge of metallurgical operations. The graduate from this department has acquired a good working knowledge of assaying, chemistry, mill-work and smelting processes.

The courses have been chosen with special reference to giving to the student in metallurgical engineering a general knowledge of modern metallurgy as a whole, and special knowledge of the metallurgy of each of the more important metals. This special knowledge is attained by lectures, readings, discussions, laboratory work and inspection of metallurgical plants.

1. Fire Assaying.

The instruction in assaying is given by means of lectures and laboratory experimentation, the practice in the laboratory illustrating the lecture-courses. The laboratory is well equipped with several different types of assay-furnaces for crucible work, scorification and cupellation, and with everything that goes to make up a well furnished assay office.

This course comprises fusion methods for gold, silver and lead; the crucible assay of oxidized ores for gold and silver in the muffle and in the pot-furnace; crucible assay of sulphide ores for gold and silver by the iron, roasting, and preliminary fusion methods; also the crucible assay of lead ores. The scorification-assay of mattes and speisses, with preliminary wet treatment; assay of litharge and lead. In the assay of base-bullion, silver-bullion and gold-bullion, the methods in use in the United States mints are followed. Sampling and the preparation of the sample for assay; making cupels.

Numerous samples are provided, all of which have been

previously accurately assayed at the College, at the smelter whence they came, or at the mint. The student works upon these until he attains a high degree of proficiency. No student is allowed to pass this subject until he has become an experienced assayer.

Prerequisites: Courses 1, 2, 3, 4 and 5 of Department III.

Time: Class-room, one hour a week, second semester.
Laboratory, eight hours a week, second semester.

Texts: Lodge, *Notes on Assaying.*
Rickett and Miller, *Notes on Assaying.*

3. General Metallurgy.

A study of the physical and chemical properties of ores and metals as determinants in extraction-methods; furnaces, their classification and structure; fuels and thermal measurements; characteristic metallurgical processes; materials and products of metallurgical processes; alloys; thermal treatment of metals preparatory to their use.

The most recent practical processes will be also presented and local metallurgical processes will be considered.

The course is to be supplemented by visits to neighboring plants and, at the end of the school-year, by vacation trips of metallurgical inspection.

Time: Three hours a week, first semester.

Texts: Roberts-Austen, *Introduction to the Study of Metallurgy.*
International Library of Technology, *Gold*, *Silver*, *Lead and Zinc.*

4. Metallurgy of Lead.

An advanced cause in lead-metallurgy; occurrence of lead; the lead reverberatory furnace; Corinthian, Silesian and English methods of treating lead ores in the reverberatory furnace; Scotch, American and Moffet types of ore-hearth; smelting lead ores in the ore-hearth; roasting-furnaces for lead ores; roasting galena as a preliminary to blast-furnace treatment; the lead blast-furnace; calculation of blast-furnace charges; details of running a lead blast-furnace; desilverization of base bullion.

Prerequisite: Course 3 of this department.

Time: Class-room; two hours a week, second semester.
Text: Hoffman, *Metallurgy of Lead.*

5. **Metallurgy of Copper.**

Occurrence of copper; roasting copper ores in heaps, stalls and roasting furnaces; blast-furnace smelting; pyritic smelting; reverberatory smelting; bessemerizing copper mattes; electrolytic refining of copper; selection of process and management of plant.

Prerequisite: Course 3 of this department.
Time: Class-room, two hours a week, first semester.
Text: Peter, *Modern Copper Smelting.*

6. **Metallurgy of Gold and Silver.**

Occurrence of gold and silver; placer mining; the patio process; crushing and amalgamating machinery; pan amalgamation; chlorination by the vat and barrel processes; cyaniding by the MacArthur-Forrest, and Siemens-Halske processes; lixivation of silver ores; pyritic smelting; refining and parting of gold bullion.

Prerequisite: Course 3 of this department.
Time; Class-room, two hours a week, second semester.
Texts: Rose, *Gold.*
Collins, *Metallurgy of Silver.*

7. **Metallurgy of Iron.**

Modern methods of the production of pig iron, wrought iron and steel; the iron blast-furnaces; white cast-iron; gray cast-iron and spiegel-iron; puddling; wrought-iron; the Bessemer and Siemen-Martin processes; steel.

Prerequisite: Course 3 of this department.
Time: Class-room, two hours a week, first semester.
Text: Howe, *Metallurgy of Steel.*

8. **Metallurgical Inspection.**

Visits of inspection to mills and reduction works. While these visits are required during the third year only, at which time the student is capable of understanding all he sees and thus deriving the maximum amount of benefit from it, students not so far advanced are advised to take these trips whenever it does not seriously conflict with other studies.

A visit may be extended by special permission and the mill or reduction works used to furnish the material for a thesis.

9. **Metallurgical Design.**

Some time during the latter part of the general course in metallurgical engineering the student devotes a part of his time to detailed and original plans for a plant for ore treatment. From year to year the conditions vary so that no two persons have the same work. The designs are based upon the surveys made by the student upon sites especially selected for peculiar conditions presented. The working plans, for the buildings, concentrators, furnaces, etc., are drawn up complete in every respect, the full bill of materials made out and the cost of the several parts and of the whole carefully estimated according to the trade conditions and labor factors existing at the time. In fine, the entire work and all computations are carried out according to the best engineering practice, and with the same care that actual construction operations require.

Time: Six hours a week, one year.

10. **Metallurgical Laboratory.**

Includes experiments in thermal measurement; thermal treatment of iron; melting points of metals and of alloys; properties of refractory materials; properties and reactions of gold, silver and copper; bullion refining and manipulation; cyanide practice and cyanide treatment of slimes.

Time: Four hours a week, second semester.

Text: Howe, *Metallurgical Laboratory Notes.*

11. **Thesis.**

Each student before receiving his degree of Metallurgical Engineer is required to prepared and to present to the Faculty an important scientific treatise upon a metallurgical subject. This treatise must be based upon work carried out by the writer while a student at the College. It must contain a complete record of all work performed by the writer upon the subject treated, the conclusions drawn from the work, and a statement of the lines along which, in the writer's opinion, it would be advisable to pursue the investigation further.

BUILDINGS AND GROUNDS.

The Campus.

The School cf Mines campus is situated on the northwest edge of Socorro. It contains 20 acres of nearly level ground within the irrigable belt. Groves of trees have been planted; and trees line the walks and drives.

Main Building.

The main building consists of three stories and a high basement. It is T-shaped, 135 feet long by 100 feet, the central rear wing being 54x32 feet. It is constructed in a very substantial manner of a beautiful gray granite, in broken ashler, trimmed with Arizona red sandstone. It is well ventilated, and has all modern conveniences, being piped for water, lighted by gas, and heated by a good hot-water system. The building is handsomely finished thruout in oiled hard woods.

As now arranged, the main floor of this building contains the president's office, the general library, the chemical laboratory, instructor's office, assay-laboratory, balance-rooms and lecture-room. The basement story contains the mineralogical museum, lecture-room, chemical supply-room, boiler-room, engine-room, lavatories and general storage-rooms. A lecture-room occupies most of the second story. The third story includes a lecture-room, supply-room, photographic dark-room and storage closets.

Engineering Hall.

The south wing of this building has already been erected. It is built of Socorro cream brick with gray trachyte trimmings.

The building is X-shaped, as planned for completion after designs by E. B. Cristy, achitect of Albuquerque. The central pavilion is two stories, while the four wings are one story. With its spacious rooms, it is peculiarly adapted to engineering instruction.

When the building is completed the entire north wing will

be devoted to draughting purposes, the light coming from above. At present the main draughting-room is in the south wing which also is a lecture room. Off this are the instructor's office, and a blue-print room. A photographic room is fitted up in the main building.

Dormitory.

The New Mexico Legislature, during its last session, appropriated $15,000 for the erection of a dormitory for the students. It is the intention that a dining-hall shall also constitute a part of this building.

EQUIPMENT.

Chemical Laboratory.

The chemical laboratory of the New Mexico School of Mines is very complete in its equipment, every thing being provided for the needs of the students in their various courses. The laboratory is equipped with desks, one of which is assigned to each student. Each desk is six by two and one-half feet and thirty-eight inches high and has a cupboard on one side and a tier of five drawers on the other, all under Yale locks. There are water and gas connections, sink, and shelves for reagents with each desk. Every student in chemistry is supplied with a complete set of reagents and all apparatus for the work to be undertaken. For general use are provided evaporation-hoods, special tables and a balance-room containing quantitative balances of Becker's construction.

The chemical lecture-room is provided with standard lecture-room chairs, especially adapted to the convenience of students in taking notes. The lecture-table, extending across one end of the room, is fitted with water and gas-connections and large sink.

Assay Laboratory.

The assay laboratory occupies the main floor and basement of the west wing of the main building. The furnaces are all new and include muffle gasoline blow-pipe furnaces of different types, and large muffle-coke furnaces. This department is conveniently arranged with shelving, drawers and boxing for fluxes and other assaying materials and supplies.

A weighing-room, containing a number of Becker's balances, is conveniently located between the furnace-room and the lecture-room. In the grinding-room, which is in the basement, is an 8-horse-power gasoline engine of Weber type, which runs the Dodge ore-crusher, a Bolthoff sample-grinder, and will supply power through a line of shafting to other machines. There are also a Bosworth laboratory crusher, bucking-board, mullers and other necessary apparatus.

Physical Laboratory.

The physical laboratory, on the third floor of the main building, contains the usual apparatus for illustrating the facts and laws of physics. In addition, there has just been added, at a considerable expense, all the apparatus necessary to perform the quantitative experiments outlined in Course 1 of Department II (p. 37).

Petrographical Laboratory.

For the microscopic study of rocks, both in elementary and advanced or graduate work, the School is well supplied with microscopes and other necessary apparatus. There has recently added to the equipment a new style large microscope, manufactured especially for this institution by Reichert, of Vienna. It is constructed especially for obtaining fine results in microphotographic work. The stand includes a Continental Model substage with rack and pinion, an Abbe substage condenser, with iris diaphragm, plane and concave universal mirror, triple nose-piece, and a full set of objectives and eye-pieces. Among the accessories are a micrometer eye-piece, compensating eye-piece, polarizing apparatus, stage micrometer, drawing apparatus, quartz-wedge, quarter-undulating mica plate, and other necessary pieces.

A rock-slicing machine with power attachments enables the student to prepare thin sections of the rocks which he is studying.

Among the series of thin-slices of rocks are a collection of types of the massive crystallines of Europe, prepared by Krantz of Bonn, and completely illustrating Zirkel, sets of Maryland massives, and other American rocks and minerals. The Sturtz collection of European rocks illustrating Rosenbush and large miscellaneous collections are expected to be soon available for study.

A rapidly growing collection of typical igneous rocks and crystalline schists of New Mexico, will afford material for thin-slice, obtained chiefly in connection with systematic investigations that are now being carried on.

Engineering Department.

For land, railroad and mine surveying the department has full sets of instruments, including transits, levels, poles,

leveling-rods, chains, pins, steel-tapes, hand-levels, compasses and clinometers.

The department has lately added to its equipment a fine large engineer's transit and all accessories, manufactured expressly for this institution, after improved designs by the Gurleys of Troy. There is included an extension tripod, auxiliary telescope, reflector, gradienter attachment, diagonal prism and solar apparatus.

Draughting Rooms.

A spacious, well-lighted draughting room is provided in the engineer building. Opening off it are the instructor's office, supply-room, blue-print room with large printing frame on steel track; developing-vat and drying-rack.

Drawing tables are furnished each student. There are private spaces for his materials and instruments. Provision is also made for models and illustrative materials.

The photographic room is located in the main building.

Mineralogical Museum.

The School owns a very fine collection of minerals of all kinds. These, properly labeled and arranged in glass cases, are housed in the north wing of the main building.

The major part of the New Mexico mineral exhibit at the Louisiana Purchase Exposition at St. Louis consisted of the collections prepared by the School of Mines. The display occupied a prominent place near the center of the Palace of Mines and Metallurgy. As the only exhibit of the kind made by a mining school it attracted wide attention.

The display was planned to center around a large colored relief-model of New Mexico on a scale of half an inch to the mile—or nearly 20 feet square. On this model was shown all the mineral resources. It was accompanied by a large colored section of the geological formations.

Arranged in a score or more of large glass cases were the leading mineral products of New Mexico, selected with special care as to value and beauty. Included were a number of cases of remarkably rare and showy zinc and copper minerals and ores. A special series consisted of zinc carbonate minerals, which for variety, delicacy of coloration and beauty

EXHIBIT OF RARE ORES AND MINERALS AT ST. LOUIS.

have never been surpassed. Two immense pyramids of showy crystalline ores were embraced in the display.

Four large special collections were of particular interest. These consisted of (1) the largest variety of zinc and copper minerals and ores from a single locality; (2) a collection of rare zinc and copper ores; (3) a unique collection of showy crystals of zinc and copper minerals; and (4) a complete smelting proposition from a single mine.

For these displays and several others, gold and silver medals were awarded.

All the collections have been returned to Socorro and now form a prominent feature in the museum of the School of Mines.

LIBRARIES.

The libraries of the New Mexico School of Mines consist of a general library and department libraries.

In the main library are the works of reference, the encyclopedias, dictionaries, journals, magazines, proceedings of the learned societies, periodical issues of other colleges, reports of Federal, State and Foreign surveys, official maps, plats and atlases, and volumes on history, travel and philosophy.

Libraries are located in the several departments of the school. These are essentially working libraries. They consist of carefully chosen treatises, text-books monographs, special contributions, and author's separates, pertaining to the respective divisions.

Fowell Library. The school has come into possession of the private library of the late Major John W. Powell, of Washington, D. C., who for many years was director of the United States Geological Survey. The collection embraces several thousand titles. The volumes are chiefly works on mining, geology and philosophy, many of which are rare, and all are of great practical value. Especially well represented is the literature relating to the Rocky Mountain region and the great Southwest. It was in these fields that Major Powell did most of his work, which has had such an important influence on the development of the mining industry. It

therefore seems particularly fitting that the library of this famous man, who had been so long identified with this western country, should find a permanent home in New Mexico.

THE TORRANCE MINE.

The School of Mines has become the owner of the Torrance Gold and Silver Mine at the base of the Socorro Mountain, only about two miles from the School campus. This mine affords excellent opportunities for the practice of mine-surveying and for a study of all the various features of practical mining. Here are to be studied a double-compartment incline shaft, a fine example of mine timbering, various levels, cross-cuts, winzes, shafts, stopes, ore-bodies with associated geological structures and many other features of interest to the student of mining engineering.

INSPECTION VISITS.

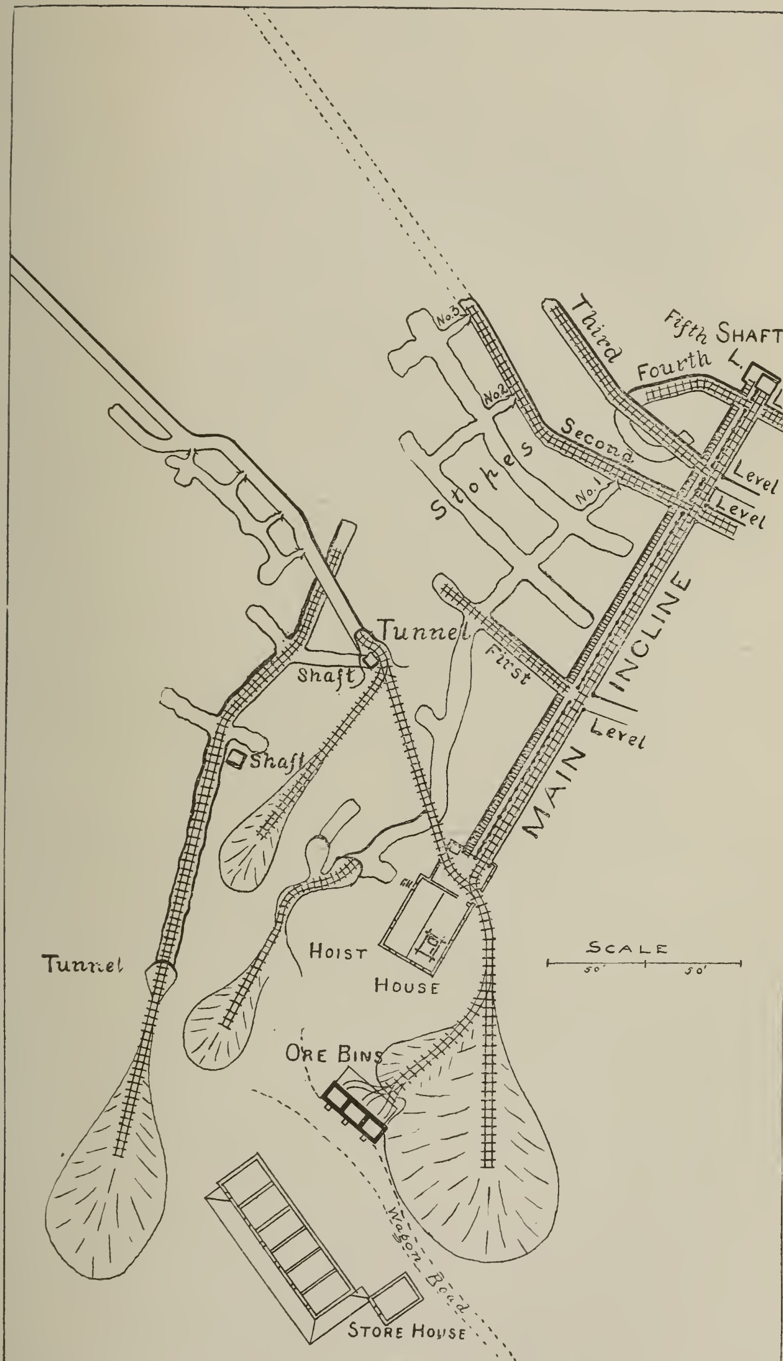
Students in the mining and metallurgical courses are expected to make a two weeks tour of inspection of the mines, concentrators and smelters lying within easy reach of Socorro under the direction of the professor of mining and metallurgy. This tour may be made either during the Christmas vacation or at the close of the school year. Special stress is laid upon the proper keeping of notes. These are fully written up each day and are made use of later as a basis of other work in connection with the regular courses. If carefully kept, they prove valuable references in later years.

At the close of the school year 1906-7, inspection visits were made to the mines, concentrators and reduction-works at El Paso, Douglas, Bisbee, Tombstone, and Cananea.

EXPENSES.

Matriculation Fee.

A matriculation fee of five dollars is required of each student before begining work in the School for the first time and, of course, is paid only once.



PLAN OF THE TORRANCE MINE.

Tuition Fee.

The fee for tuition is fifty dollars a semester except to citizens of New Mexico, the tuition fee for the latter being ten dollars a semester. This fee is payable at registration and its payment, after matriculation, admits the student to all class-room instruction.

Laboratory Fees.

The laboratory fees are intended to cover the cost of gas, water and materials for which the student does not pay directly and to compensate for the depreciation, due to use, in the value of the apparatus. These fee are payable at the time of registration and are as follows; General Chemistry, Qualitative Analysis, Quantitative Analysis, Water and Fuel Analysis, Wet Assaying, each $5.00; Fire Assaying, $10.00; Blowpipe Analysis, $3.00; Biology, $2.00.

A deposit of $3.00 is required from each student who registers for any one of the foregoing courses except those in Blowpipe Analysis and in Biology. This deposit will be returned to the student after deducting any amount which may be due for the breakage of apparatus.

Graduation Fee.

The graduation fee, payable before delivery of diploma, is as follows:

Mining, Metallurgical, or Civil Engineer $10.00
Bachelor of Science 5.00

Board and Rooms.

Rooms may be obtained at a cost varying from $6.00 to $8.00 a month and board, at the hotels and best boarding-houses, at $5.00 a week, but lower rates than these are obtainable. The cost of living will be materially reduced for the students as soon as the dormitory, with its dining-hall, is erected.

Books.

Books are furnished to the student at cost.

SCHOLARSHIPS AND PRIZES.

Scholarships.

Through the generosity of the members of the Board of Trustees, of the 37th General Assembly of New Mexico and of the Allis-Chalmers Company, the New Mexico School of Mines has been able to establish a system of scholarships. These scholarships are awarded annually as honors, the main object being to encourage earnest effort on the part of those who wish to prosecute studies related to mining in this institution.

School of Mines State-Scholarships. To one student from each state of the Union, is open a scholarship yielding $100.00 annually. Eeach scholarship may be held for one year and is assigned to that applicant who shows, either by certified statement or by examination, the greatest proficiency in subjects already pursued by him. Applcation must be made in writing to the President and must be accompanied by a certified statement of subjects pursued and the grades received therein, unless the applicant prefers to pass an examination in the subjects for which he seeks credit. Holders of scholarships are not exempt from the specified fees.

In case, in any one year, worthy candidates do not offer themselves from any one state, the Board, at its option, may reserve such appointments, or award them to applicants from other states, preference being given to students who already hold college degrees, or who present evidence of unusual attainments in mining studies.

School of Mines County-Scholarships. Scholarship are open to two students from each county in New Mexico. These scholarships yield $20.00 annually and are subject to the same conditions as the State-Scholarships.

New Mexico Scholarships. The 37th General Assembly of New Mexico gave to each representative, to each councilman and to each board of county commissioners the privilege of appointing a student to a scholarship in any one of the educational institutions of the Territory and provided an appropriation of $200.00 for each appointee.

Allis-Chalmers Scholarship. To one members of each year's graduating class there is offered by the Allis-Chalmers Company, manufacturers of mining and heavy machinery, with large works at Chicago, Milwaukee and Scranton, an opportunity for four month's study and employment in any of its plants, and an emolument of $150.00.

This scholarship is awarded by the Board of Trustees on the recommendation of the Faculty from those graduates of the year filing application before the 10th of June. The opportunity is an exceptional one to observe and study the building of all kinds of modern mining and metallurgical constructions.

Prizes.

The Brown Medal. Hon C. T. Brown of Socorro, offers annually a gold medal to the student who, while doing a full years's work, has shown the greatest proficiency in the subjects of Wet Assaying and Fire Assaying. The medal is awarded each year at commencement. Last year, the medal was received by Mr. Rue N. Hines, of Socorro.

SUMMER WORK.

The proximity of the School to mineral properties, mines and smelters, makes it easy for the student to secure employment during the summer (and during the Christmas vacation if desired) and at the same time to acquire much practical experience in the line of his profession. That this advantage has been appreciated is shown by the large proportion of students who yearly make use of this opportunity. During the past years, land-surveying, mine-surveying, geological surveying, assaying and mining have been attractive fields of work for the students during the vacations.

DEGREES.

The degrees of Bachelor of Science, Mining Engineer and Civil Engineer are conferred by the Board of Trustees upon recomendation of the Faculty.

The degree of Bachelor of Science is conferred upon those who, as students of this institution, have completed the prescribed collegiate courses of the first three years in any one of the several curricula. This degree is also conferred upon those who, as students of this institution, have completed the courses which represent one full year's work in any one of the several curricula and have given satisfactory evidence of having previously completed the other courses of that curriculum.

The degree of Mining Engineer is conferred upon each one who, as a student of this institution, has completed the prescribed courses of the four-year curriculum in Mining Engineering, Metallurgical Engineering or Mining Geology, has presented an original and scholarly dissertation in the line of his work and has had this dissertation accepted by the Faculty. The degree is also conferred upon each one who, as a student of this institution, has completed the courses which represent one full year's work in one of the four-year curricula just named, has given satisfactory evidence of having previously completed the other courses of that curriculum and has complied with the specified conditions concerning a dissertation.

The degree of Civil Engineer is offered upon terms similar to those required in the case of the mining engineer, except that the candidate substitutes, in some of his later work, courses which relate more directly to the profession he expects subsequently to follow.

Work done at other colleges by candidates for a degree may be accepted so far as it corresponds to the work done here, but, in each case, the Faculty reserves the right to decide whether the previous work has been satisfactory.

It is expected that the thesis in each case shall be prepared with sufficient care and exhibit sufficient intrinsic evidences of independent investigation to warrant its publication, in whole or in part.

COMMERCIAL ANALYSES.

The wide demand which exists in the great mining district of the Southwest for disinterested and scientific tests and practical investigations has lead to the establishment, by the New Mexico School of Mines, of a bureau for conducting commercial work relating to mining and metallurgy.

The performance of such work is made possible, and accurate results assured, by reason of the exceptional facilities of the laboraties of the school and the extensive practical experience of the instructors. The rapidly increasing amount of this work intrusted to the school is sufficient evidence in itself that the plan has been long needed to further the development of the mineral resources of the region.

A special act of the Legislature makes provision for carrying on commercial testing. The section from the law governing the School of Mines, Chapter 138, Section 38, Acts of 1889, reads: "The Board of Trustees shall require such compensation for all assays, analyses, mill-tests or other services performed by said institution as it may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines."

A special circular is issued, giving the schedule of charges, other necessary information and methods of preparing and shipping samples. Copies are mailed on application. By special resolution, it is required that all charges shall be paid in advance.

Commercial Assaying. The assaying fcr gold, silver, copper lead, zinc and the common metals, is carried on in all its various phases. All work is run in duplicate and in case of any nonconcordant results such assay is repeated. Particular attention is paid to umpire work.

Determinations of silica, iron, alumina, magnesia and manganese and of the rarer metals such as uranium, vanadium, nickel and cobalt are made according to the best methods.

Water Analysis. The chemical analysis of waters for city-water supplies, boilers and domestic use and of mineral and mine-waters has, of late, assumed great importance. The chemical laboratory of the School is fully equipped for this work and in the case of bad waters, remedies and methods to

be used to improve the waters for specific purposes are suggested. A large number of analyses of waters from the Southwest have already been made, and very interesting results obtained.

Fuel Analysis. Another branch of work which has been constantly receiving more attention has been an inquiry into the fuel values of the coals of the region. Complete analyses and heat tests, have been made of some of the principal deposits. With the work already done, the results of new analyses are made of special value on account of the comparative figures that can be supplied.

DIRECTORY OF GRADUATES AND FORMER STUDENTS.†

ARTHUR H. ABERNATHY. Cananea Mexico.

Student 1898-1901. From Pinos, Zacatecas, Mexico, Assayer, Cananea Smelting Works, since 1901.

C. E. BARCLAY. Maria, Texas.

(A. B. University of Virginia).

Student, 1896-97. From Bowling Green, Kentucky.

JAMES F. BERRY. Mexico City, Mexico.

Student 1904-5. From Socorro, N. M. Assayer with American Smelting and Refining Co., at Aguas Calientes, since 1905; Assayer, City of Mexico 1906.

LOUIS AUGUST BERTRAND. Mapimi, Durango, Mexico.

Student, 1905-7. From Conway, Iowa. Student Ecolé Professionella de l'East, Nancy, Lorraine, 1890-95; Instructor in Mathematics and French, New Mexico School of Mines, 1895-6; Chemist, El Paso Smelting Works, El Paso, Texas; Assayer and Surveyor, Consolidated Kansas City Smelting and Refining Co., Chihuahua, Mexico; Superintendent Carmen Mines, Coahuila, Mexico; Superintendent Compania Mineros de Penales, Mapimi Durango, Mexico, since 1901.

CHAUNCEY E. BUTLER.* Dedrich, California.

Student, 1893-6. From Kelley, New Mexico. Assayer Cibolo Creek Mill and Mining Co., San Francisco, California, 1896; Assayer and Furnace Superintendent, El Compania Minera Lustre, Magistral, Estado de Durango, Mexico, 1897-98; Chemist and Assayer, United Verde Copper Co., Jerome, Arizona, 1898-1903; Superintendent Trinity County Gold Mining Co., and Jenny Lind and Maple Mining Co., Dedrich, California, since 1903.

R. HARLAND CASE. Organ, New Mexico.

Student, 1902-5. From Cerrillos, N. M. Chemist, Compania Metalurgica de Torreon, Torreon, Mexico, 1905-6; Asistant Superintendent, Bonanza Mine, Zacatecas, Mexico, 1906; Assistant-Manager, Stephanson-Bennett Mining and Milling Co., Organ New Mexico, 1906-7.

EDWARD C. CHAMNEY. Minnehaha, Arizona.

Student, 1899-1900. From Shipley, Ontario, Canada. Assistant in General Science, New Mexico School of Mines, 1900-01; Assayer, Oro Mining Co., Minnehaha, Arizona, since 1901.

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† Information concerning former students not here listed or concerning changes of address of those already listed will be gladly received.

* Deceased.

VIVIAN V. CLARK. Albuquerque, New Mexico.

Student, 1896–8. From Kelley, New Mexico, Assayer Bland Milling Co.. Bland, New Mexico, 1898–9; Superintendent, Navajo Gold Mining Co., Bland, New Mexico, 1900; Manager, Higueras Gold Mining Co., Sinaloa, Mexico, 1901; Mine Operator, Albuquerque, New Mexico, since 1902.

DAVID JOSHUE CLOYD. Aguas Calientes, Chihuahua, Mexico.

Student, 1899–1900. From Decatur, Illinois. Chemist in Wardman Assay Office, Aguas Calientes, Chihuahua, Mexico, since 1900.

SAMUEL COCKERIL. Chicago, Illinois.

(A. B. Valparaiso University.)

Student, 1904-6. From North Fork, Virginia. Holder of Allis-Chalmers Scholarship. 1906–7.

THEODORE STEWARD DELAY. Creston, Iowa.

(B. S. and M. E., Missouri School of Mines.)

Graduate Student, 1893–5. From Creston, Iowa. Assistant Professor of Chemistry, New Mexico School of Mines, 1894; Assayer, Tassel Mining and Milling Co., Alma, Colorado, 1895; Assistant Superintendent, I. X. L. Milling and Refining Co., Breckenridge, Colorado; Manager, Hoosier-Yukon Mining and Milling Co., Forty-Mile District, Alaska; Metallurgist, Creston-Colorado Mining Co., Creston Iowa, since 1900.

LEON DOMINIAN. Zacatecas, Mexico.

(B A. Roberts College, Constantinople. 1898; C. I. M. Mining School University of Liege, 1900.)

Graduate Student, 1903-4. From Constantinople, Turkey, Assistant, U. S. Geological Survey, 1903; Instructor in Mathematics, New Mexico School of Mines, 1903-4; Engineer to Victor Fuel and Iron Co., Denver, Colo., 1904-6, Superintendent, Bonanza Mine, Zacatecas, Mexico, 1906.

ROBERT CASIANO EATON. Comanjo, Jalisco, Mexico.

Student, 1893-4. From Socorro, New Mexico. Sampling Mill Foreman, Compania Metalurgico Mexicana, San Luis, Potosi, Mexico, 1894-98; Superintendent, Muriedas Smelting Works, Xichu, State of Guanajuato, Mexico, 1898; Superintendent of Railroads, Compania.

ALEXANDER WALTER EDELEN. Elkton, Colorado.

Student, 1905-6. From Baltimore, Md. Assistant Superintendent, Elkton Consolidated M. and M. Co., 1906. Assistant Superintendent Bonanza Mine, Zacatecas, Mexico, 1907.

HARRY THORWALD GOODJOHN. Mapimi, Mexico.

Student, 1902–3. From Pittsburg, Texas. Assayer, Cia Metalurgica de Torreon, Torreon, State of Coahuila, Mexico, 1903-1906; Chief Chemist, Mapimi Smelter, 1906.

SAMUEL JAMES GORMLEY. West Jordan, Utah.

Student, 1895-6. From Mt. Vernon, Iowa. Assistant Professor of Engineering, New Mexico School of Mines, 1895-7; Assistant Assayer, Anaconda Copper Minning Co., Anaconda, Montana, 1897-1900; Chemist to same company, 1900-02; Superintendent of Sampling Works, Washoe Smelting Co., Anaconda, Montana, 1902-06, Smelter Superintendent, Bingham Copper and Gold Mining Co., West Jordan, Utah, since 1906.

ANTON HOGWALL. Nogal, New Mexico.

Student, 1898-99. From White Oaks, New Mexico. Assayer, Buckeye Mining Co., Water Canyon, New Mexico, 1900; Assayer, South Homestake Mining Co., and Helen Rae Ming. Co., White Oaks, New Mexico, 1901; Assayer, American Gold Mining Co., Nogal, New Mexico, since 1902.

CARL JOHN HOMME. Gulf Creek, N. S. W., Australia.

(A. B. St. Olaf College)

Graduate student, 1899-1900. From Wittenburg, Wisconsin, Assayer and Chemist to Candelaria Mining Co., El Paso, Texas, 1900-01; Assistant Superintendent Gulf Creek Mining Co., Gulf Creek, New South Wales, Australia, since 1902.

WILLIAMS ELIAS HOMME. Gulf Creek, Australia.

(A. B. St., Olaf College)

Graduate student, 1902-03, From Wittenburg, Wisconsin. Assayer, Gulf Creek Mining Co., Gulf Creek, New South Wales, Australia. 1902.

HAYNES A. HOWELL. Acapulco, Mexico.

Student, 1900-1905. From Socorro, N. M. Civil engineer on railway from Acapulco, Mexico, since 1906.

HARRY J. HUBBARD. Temosachic, Mexico.

Student, 1905-6. From Bisbee, Arizona. Mine-foreman, for Greene Gold-Silver Co., at La Navidad Mine, Temosachic, Mexico since 1906.

ARCHIBALD J. HUNT. Mapimi Mexico.

Student, 1903-5, From Providence, R. I. Assistant Chemist at Mapimi Smelter, since 1906.

JOHN AUGUST HUNTER. Aguas Calientes, Mexico.

(B. S., New Mexico School of Mines, 1903)

Student, 1899-1903. From Socorro. Chemist, Consolidated Kansas City Smelting Co., El Paso, Texas, 1893-4; Chemist and Metallurgist, American Smelting and Refining Co., Aguas Calientes, Mexico, since 1904.

CHARLES THAYER LINCOLN. Iowa City, Iowa.

(S. B., Massachussetts Institute of Technology, 1901.)

Graduate student, 1902-3. From Boston, Massachussetts. Chemist to American Bell Telephone Co., Boston, Mass., 1901-2; Assistant in

Analytical Chemistry, New Mexico School of Mines, 1902-3; Acting Professor, same, 1903-4; Instructor in Chemistry, Iowa State University, Iowa City, since 1904.

FRANCIS CHURCH LINCOLN. Patagonia, Arizona.

(S. B., Massachussetts Institute of Technology.)

E. M., New Mexico School of Mines, 1902. Assayer to San Bernardo Mining and Milling Co., 1900; Chemist to Butterfly Terrible Gold Mining Co., 1900-01; Professor of Chemistry and Metallurgy, New Mexico School of Mines, 1901-2; Professor of Metallurgy, 1902-04; Assistant Superintendent, Ruby Gold and Copper Co., Ortiz, State of Sonora, Mexico, 1904; General Manager, Arizona Gold and Copper Co., Patagonia, Arizona, since 1904.

HARRY C. MAGOON. Chicago, Illinois.

Student, 1899-1900. From Chicago, Illinois. Engineer with Illinois Steel Company, since 1990.

CONRAD M. MEYER. New York, N. Y.

(A. B., New York University, M. D., Bellevue Hospital.)

Graduate student, 1900-01. From New York City. Mining Engineer, 136 5th Avenue, New York City, since 1901.

TARVER MONTGOMERY. Santa Ana, California.

Student, 1899-1901. From Santa Ana, California. County Surveyor, Orange County, California, 1900-01. Assistant Engineer, Temescal, Water Co., Corona, California, 1901; Transitman, San Pedro, Los Angeles, and Salt Lake Railroad Co., 1901-02; Assistant Engineer, Pacific Electric Railroad Co., Santa Ana, California, since 1902.

ERLE D. MORTON. Aurum, Nevada.

Student, 1903-5. From Los Angeles, Cal. Assistant Superintendent of the Giroux Consolidated Mines Co., of Kimberley, Nevada, since 1905.

WILLIAM FREDERICK MURRAY. Denver, Colorado.

Student, 1904-6. From Raton, New Mexico, In the General Mining Engineer's Office of the Victor Fuel Co., at Denver, since 1906.

PATRICK J. O'CARROL.*

(B. A. University of Dublin, Ireland.)

Graduate student, 1898-9. From Dublin, Ireland. Mine Operator, Gallup, New Mexico, 1899-1901.

ALVIN OFFEN.*

Student, 1895-6. From Butte, Montana. E. M., 1896; Assistant Superintendent, Philadelphia Mine, Butte, Montana, 1896-7.

JUAN PALISSO. MEXICO.

Student, 1903-4. From Barcelona, Spain, Mining Engineer, Mexico.

* Deceased.

FOUNT RAY. Italy, Texas.

Student, 1991-2. From Waxahachie, Texas. General Manager, Lena Mining and Concentrating Co., Lordsburg, New Mexico, 1902; Cashier, Citizens National Bank, Italy, Texas, since 1902.

ALBERT BRONSON RICHMOND. Patagonia, Arizona.

Student, 1900-01. From Las Priestas, Sonora, Mexico. Superintendent, Ramona Mill Co., Gairlon, Sonora, Mexico, 1901-02; Assayer, Patagonia Sampling Works, Patagonia, Arizona, 1902; Assayer and Metallurgist, Patagonia, Arizona, since 1902.

DELL FRANK RIDDELL. Chicago, Illinois.

(Ph. G., Chicago College of Pharmacy, 1896; B. S., Nebraska State University, 1901.)

Graduate student, 1903-5. From Sioux Falls, South Dakota. Professor of Chemistry, Sioux Falls College, 1901-3; Instructor in Chemistry, New Mexico School of Mines, 1903-4; Acting Professor of Assaying, same, 1904-5; M. E., same, 1905; Holder of Allis-Chalmers Scholarship, 1905-6.

WILLIAM CARLOS STEVENSON. Redlands, California.

Student, 1900-01. From Hillsboro, Ohio. General Manager, Mining Corporation, Albuquerque, New Mexico, since 1901.

JOHN STUPPE. Torreon, Coahuila, Mexico.

Student, 1903.4. From El Paso, Texas. Accounting Department, El Paso Smelting Works, El Paso, Texas, 1896-1902; Metallurgical Department, Compania Metalurgica de Torreon, Torreon, Coahuila, Mexico, since 1902.

LEO RICHARD AUGUST SUPPAN. St. Louis, Missouri.

Student, 1895-6. From St. Louis, Missouri. B. S. in Chemistry and Metallurgy, 1896; Instructor in Chemistry, New Mexico School of Mines, 1895-7; Graduate Student, Johns Hopkins University, 1897-8; Professor of Chemistry, Marine-Sims College of Medicine, St. Louis, since 1898.

CHARLES L. SEARCY. Monterey, Mexico.

Student, 1903-4. From Peoria, Illinois. Mining Engineer, Monterey, Mexico.

CHARLES H. SHAMEL. Taylorville, Illinois.

(B., S., M. S., Illinois State University; L. L. B., Michigan University.)

Graduate student, 1901-2. From Taylorville, Illinois. Attorney at Law, Taylorville, Illinois, since 1902.

OLIVER RUSSELL SMITH. Socorro, New Mexico.

(B. S., Kansas College of Agricultnre and Mechanic Arts. 1898.)

Graduate Student, 1899-1901. From Manhattan, Kansas. B. S., in Civil Engineering, New Mexico School of Mines, 1901; Assistant in Mathematics and Draughting, New Mexico School of Mines, 1900-01: Instructor in Engineering and Drawing, New Mexico School of Mines, 1901-2; C. E., New Mexico School of Mines, 1903; Assistant-Professor

in Engineering and Drawing, New Mexico School of Mines, 1902 Assistant-Surveyor, U. S. Land Office, 1902; City Engineer of Socorro, New Mexico, 1902; Deputy Mineral Surveyor, U. S. Land Office, 1903; Professor of Civil Engineering, New Mexico School of Mines, since 1902.

OTTO JOSEPH TUSCHKA. Monterey, Mexico.

Student, 1893-7. From Socorro, New Mexico. E. M., in Metallurgy, 1897; Assayer and Chemist, Graphic Smelting Works, Magdalena, New Mexico, 1897-8; Graduate student, New Mexico School of Mines, 1898-99 Assistant Sampling-Mill Foreman and Chemist, Guggenheim Smelting and Refining Co., Monterey and Aguas Calientes, Mexico. 1899-1900: Assayer, Seamon Assay Laboratory, El Paso, Texas, 1900; Chemist. Compania Minera Fundidora y Afinadora "Monterey," Monterey, Mexico, since 1900.

MILTON BENHAM WESCOTT. El Paso, Texas.

Student, 1904-5. From Chicago, Illinois. Assistant County Surveyor of El Paso County, Texas, since 1905.

PATRICK ANDREW WICKHAM. Victor, Colorado.

Student, 1893-4. From Socorro, New Mexico. Assistant, Rio Grande Smelting Works, Socorro, New Mexico; Mechanical Engineer, Buckeye Mining Co. and Albemarle Mining Co., Bland, New Mexico, 1898-99; Mechanical Engineer, Mt. Beauty Mining Co., Cripple Creek, Colorado, 1899-1900; Engineer, Empire State Mining Co., Cripple Creek, Colorado, 1900-01; Engineer, Guggenheim Exploration Co. Minas Tecolotes, Santa Barbara, Mexico, 1901-02; Residence Engineer, Independence Consolidated Mining Co. Independence, Colorado, since 1902.

WAKELEY A. WILLIAMS. Grand Forks, British Columbia, Canada.

Student, 1893-4. From Council Bluffs, Iowa. Assistant, Superintendent and Metallurgist, Granby Consolidated Mining, Smelting and Power Co., Grand Forks. since 1898.

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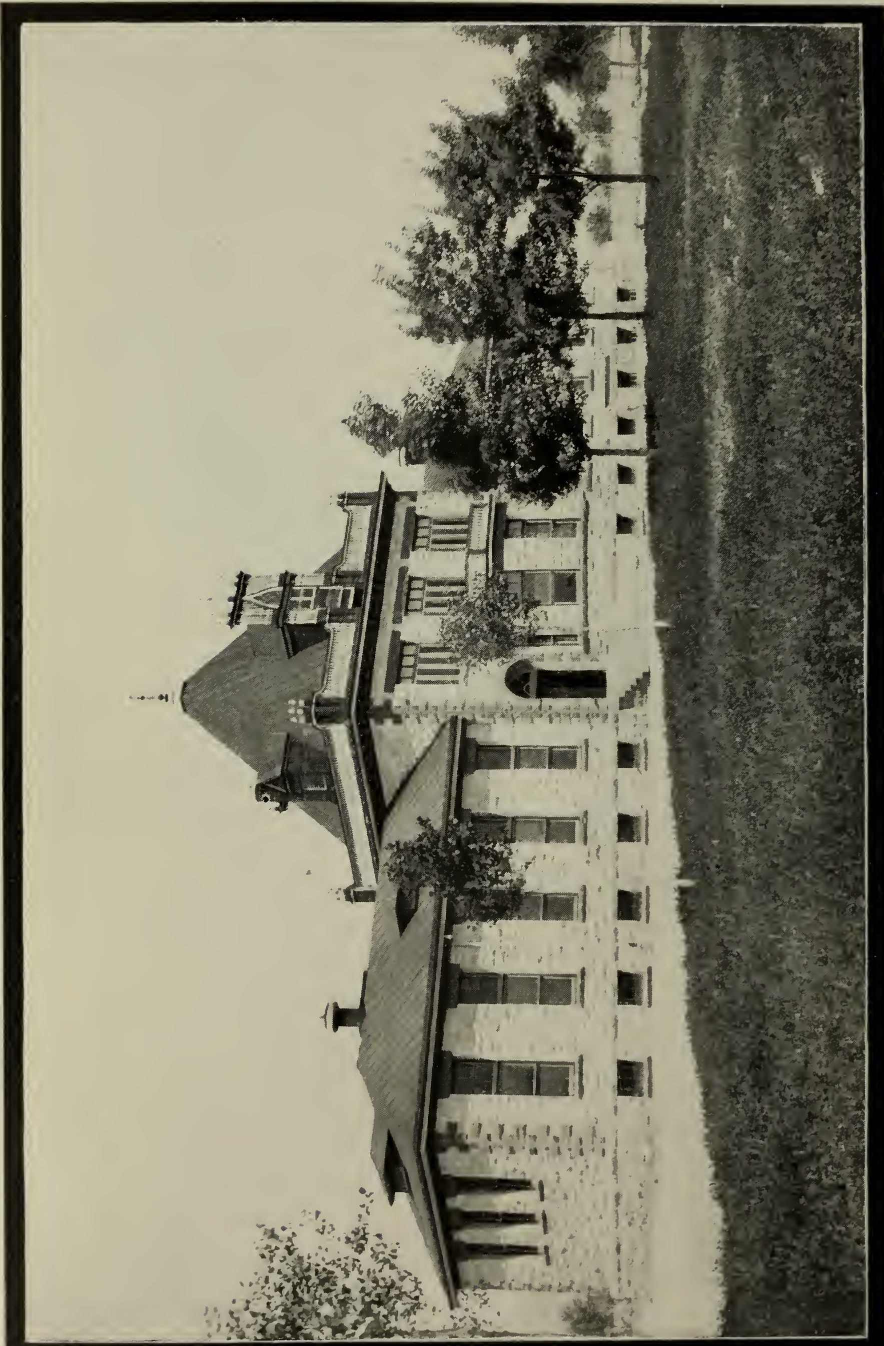
NEW MEXICO SCHOOL OF MINES

1907-8



ANNUAL REGISTER

OF THE

NEW MEXICO SCHOOL OF MINES

SOCORRO, N. M.

1907-8

WITH ANNOUNCEMENTS FOR 1908-9.

SANTA FE, N. M.:
THE NEW MEXICAN PRINTING COMPANY.
1908.

CALENDAR.

1908-1909.

First Semester:

September 12, Saturday—Entrance examinations.
September 14, Monday—Registration of students.
September 15, Tuesday—Recitations begin.
November 26 and 27, Thursday and Friday—Thanksgiving recess.
December 23, Wednesday—Christmas vacation begins.
January 7, Thursday—Work resumed.
January 25, Monday—Examinations begin.

Second Semester:

January 29, Friday—Registration of students.
January 31, Monday—Recitations begin.
February 22, Monday—Washington's birthday.
May 30, Monday—Examinations begin.
June 3, Friday—Commencement.

FACULTY.

ROBERT PEELLE NOBLE, Ph. B., A. M., *President of the Faculty, Professor of Chemistry.*

Ph. B., DePauw University, 1891: Assistant in Chemistry, DePauw University 1889; Graduate student, Johns Hopkins University, 1892; A. M. DePauw University, 1894; Principal Crawfordsville High School, 1894-1897; Graduate student, University of Chicago, 1897-1898; 1900-1901 and 1903-1904; Professor of Chemistry, Vincennes University, 1898-1900; Assistant Professor of Chemistry, Armour Institute of Technology 1901-1904; Professor of Chemistry, New Mexico School of Mines, 1904 —; President of New Mexico School of Mines 1906—.

EMMET ADDIS DRAKE, A. B., A. M., *Professor of Languages.*

A. B., Wisconsin University, 1882; A. M., Wisconsin University, 1887; Assistant Engineer, Northern Pacific Railroad Co., 1882-1883; Instructor in Rhetoric and Oratory, Wisconsin University, 1883-1884; Instructor in Missouri School of Mines, 1884-1891; General Manager, Columbia Mining Co., 1891-1897; Professor of Languages, New Mexico School of Mines, 1897.—; Editor Socorro Chieftain, 1900.—

REINOLD VERNON SMITH, B. S., *Professor of Mining and Metallurgy.*

B. S., University of Utah, 1895; Superintendent of Schools, Bimgham, Utah, 1895-1896; Purchasing Agent, R. G., S. M. and P. Ry., Juarez Mexico, 1896-1898; With Smith and Lyon, Mining Engineers, Salt Lake City, Utah, 1898-1900; Metallurgist, Dexter-Tuscarora Consolidated Gold Mining Co., Tuscarora, Nevada, 1900-1903; Metallurgist, Mercur Consolidated Gold Mining Co., Mercur, Utah, 1903; Metallurgical Engineer, Sevier Consolidated Gold Mining Co., Sevier, Utah, 1903-1904; Instructor in Chemistry and Physics, University of Utah, 1904-1906; Professor of Mining and Metallurgy, New Mexico School of Mines, 1906—.

ARTHUR KINNEY ADAMS, B. S,, A. M., *Professor of Geology and Mineralogy.*

Student, Worcester Polytechnic Institute, 1900-1903; B. S., Harvard University, 1904; Assistant in Geology, 1904; Student, Harvard University Summer School, 1903, 1904; Graduate Student, 1905; A. M., Geology, 1905; Assistant on United States Geological Survey, 1905; Graduate Student in Mining Engineering and Assistant in Geology at Massachusetts Institute of Technology, 1905-1906; Assistant on United States Geological Survey, 1906-1907; Professor of Geology and Mineralogy, New Mexico School of Mines, 1907—.

WILLIAM LEVI RICHER, Ph. B., *Professor of Mathematics.*

Ph. B., Otterbein University, 1896; ibid, University of Chicago, 1898; Professor of Mathematics, Shenandoah Institute, 1896-1897; Graduate Student in University of Chicago, 1898-1899, Instructor in Coshocton High School, 1898-1901; Principal, Coshocton High School, 1901-1907; Professor of Mathematics, Otterbein University Summer School, 1902; Professor of Mathematics, New Mexico School of Mines, 1907—.

GEORGE FREDERICK ECKHARD, B. S., *Professor of Civil Engineering.*

M. Di., Iowa State Normal School, 1900; B. S., University of Iowa, 1905; Instructor in Mathematics, Rock Rapids High School, 1900-1901; Instructor in Mathematics, Carroll High School, 1901-1902; with Wm. Schott Contracting Co., 1903; Illinois Central Railroad Co., 1904; Cuba Eastern Railway, 1905; Intructor in Cedar Falls High School and University of Iowa, 1906-1907; City Engineer of Socorro, 1907—; Professor of Civil Engineering, New Mexico School of Mines 1907—.

ETHELBERT WEBB WALDRON, A. B., *Principal of the Academy.*

A. B., University of Michigan, 1905; Instructor in Delta, Colo., High School 1906; United States Indian Service, 1907; Principal of the Academy, New Mexico School of Mines, 907—.

MISS ANNE W. FITCH .... *Registrar.*

LECTURERS.

JOHN R. PACKARD,
Travels in Asia.

MARTIN B. ZERENER,
The Geology, Mining and Metallurgy of the Rand District.

JAMES G. FITCH,
Mining Law.

C. T. BROWN,
The Lead and Zinc Deposits in New Mexico and Mexico.

NEW MEXICO SCHOOL OF MINES.

HISTORICAL SKETCH.

The New Mexico School of Mines is an institution founded by act of the Legislature of 1889. This act provided for the support of the School by an annual tax of one-fifth of a cent on all taxable property.

Under an act of the Legislature, approved February 28, 1891, a board of trustees was appointed, an organization effected and immediate steps were taken towards the erection of necessary buildings. During this same year, a special appropriation of $4,000 was made for the partial equipment of the chemical and metallurgical laboratories.

Early in 1892, a circular of information, regarding the New Mexico School of Mines, at Socorro, New Mexico, was issued by the Board of Trustees. In this circular, the aims were fully set forth. The following year, a president was chosen and students in chemistry were admitted; but it was not until the autumn of 1895 that the mining school was really opened.

In 1893 a second special appropriation of $31,420 was made, to enable the School of Mines to be organized in accordance with the policy outlined by the act creating the institution.

By Act of Congress, approved June 21, 1895, the New Mexico School of Mines received for its share of certain grants of land, fifty thousand acres for its support and maintenance. From this source of revenue, the School has already received more than $17,000.

In 1899, the Legislature increased the former levy of one-fifth of a cent to twenty-seven and one-half one-hundredths of a mill.

In 1901, the 34th General Assembly recognized the growing importance of the School by further increasing the tax levy to thirty-three one-hundredths of a mill. It also authorized the bonding of any portion of the grant of lands in order to more thoroughly equip the School with buildings and apparatus.

In 1903, the 35th General Assembly raised the millage to forty-five hundredths of a mill. This, with greatly increased assessed valuation of property, doubled the income of the School over that of the previous year.

In 1905, an appropriation of $14,000 was made by the Legislature for the maintenance of the School.

In 1907, this appropriation was increased to $15,000, and an additional appropriation of $15,000 was made for the purpose of erecting a dormitory.

STATUTES RELATING TO THE SCHOOL.

Some of the sections of the act creating the School of Mines are as follows:

The object of the School of Mines created, established and located by this act is to furnish facilities for the education of such persons as may desire to receive instruction in chemistry, metallurgy, mineralogy, geology, mining, milling, engineering, mathematics, mechanics, drawing, the fundamental laws of the United States and the rights and duties of citizenship, and such other courses of study, not including agriculture, as may be prescribed by the Board of Trustees.

The management and control of said School of Mines, the care and preservation of all property of which it shall become possessed, the erection and construction of all buildings necessary for its use, and the disbursement and expenditure of all moneys appropriated by this act, or which shall otherwise come into its possession, shall be vested in a board of five trustees, who shall be qualified voters and owners of real estate; and said trustees shall possess the same qualifications, shall be appointed in the same way, and their terms of office shall be the same, vacancies shall be filled in like manner, as is provided in sections 9 and 10 of this act. Said trustees and their successors in office shall constitute a body under the name and style of "The Trustees of the New Mexico School of Mines," with right as such of suing and being sued, of contracting and being contracted with, of making and using a common seal and altering the same at pleasure, and of causing all things to be done necessary to carry out the provisions of this act. A majority of the board shall constitute a quorum for the transaction of business, but a less number may adjourn from time to time.

The immediate government of their several departments shall be intrusted to the several faculties.

The board of trustees shall have power to confer such degrees and grant such diplomas as are usually conferred and granted by other similar schools.

The trustees shall have power to remove any officer, tutor or instructor or employee connected with said school when, in their judgment, the best interests of said school require it.

The board of trustees shall require such compensation for all assays, analyses, mill-tests, or other services performed by said institution as they may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines for said institution, and an accurate account thereof shall be kept in a book provided for that purpose.

LOCATION.

The New Mexico School of Mines is located at Socorro, the county-seat of Socorro County. Socorro is in the central part of the county and is on the main line of the Atchison, Topeka and Santa Fe Railway, 75 miles south of Albuquerque, and 180 miles north of El Paso. The Magdalena branch of the Santa Fe railway starts from this place.

Socorro is situated in the broad valley of the Rio Grande, at the foot of the Socorro range of mountains, the altitude of the town is about 4,600 feet above the sea and the location is pre-eminently pleasant and healthful. The mean temperature for 1907 was 57.4°, the highest (in June) 105°, and the lowest (in December) 11°. The air is exceedingly dry and the town has long been attractive to health-seekers who wish a mild and invigorating climate, and many persons every year have sought its hospitalities.

The scenery is quite diversified by plains, broad valley slopes, mesas, varied hill country and lofty mountains. In the city are two hotels and a number of good boarding houses. The churches represented are the Presbyterian, Roman Catholic and Episcopal.

Socorro has its own system of public water supply. The water is very soft and pure, and is furnished by hot springs which, four miles away, issue from the Socorro mountain. Two newspapers are published and a modern artificial ice plant and a large roller-process flouring mill are in operation.

The ground immediately adjacent to the School of Mines includes irrigable land, plateaus and mountain formations, all affording an excellent field for practice in surveying, the laying out of a railroad and irrigating canals, topography, mine engineering and geology, so that students can be prepared at the very door of the School in those branches which usually require tedious excursions from most other schools.

The New Mexico School of Mines enjoys the natural advantage of being located in the midst of a region peculiarly rich in minerals of nearly all kinds, and is within easy reach of the most varied geological conditions, all of which are within a radius of

thirty or forty miles of Socorro. Almost the entire geological column from the precious metal-bearing formations of the Archean to the coal beds of the Tertiary is here exposed. The industrial processes connected with mining and metallurgy may be seen admirably illustrated at Magdalena, Kelly, Rosedale,. San Pedro, Hillsboro, Deming, Fierro, Silver City, Pinos Altos, Los Cerrillos, Gallup, Carthage, and elsewhere within easy reach of the School. These illustrate the most modern methods of mining, milling, ore-dressing, concentrating, smelting, lixiviation, cyaniding and other metallurgical processes.

A number of mines of various kinds, smelters, irrigating systems and other engineering works are accessible to the School. Within a few hours' ride by rail, are many important mining camps. The longer excursions bring the student to some of the most famous mines in southwestern United States. Some of the longest worked lodes in America are in this region. For more than 350 years, they have yielded their wealth to the European and, centuries before his advent, gave up even greater treasures to the native races.

If we look into the history of modern mining schools, we find that each becomes most celebrated along the line for which its locality is best known on account of its natural surroundings. Few institutions of learning are more dependent for success upon what may be called the accident of geographical location than the mining school. It may be truthfully said that no mining school is more fortunately situated so far as natural environment is concerned than that of New Mexico.

PURPOSE.

The ideal to which the New Mexico School of Mines tenaciously holds is the practical directing of young men to take active part in the development of the mineral wealth of our country and the the world.

The New Mexico School of Mines is a territorial institution. It was established primarily to promote mining and mining interests in southwestern United States. However, it has a much wider scope, providing, as it does, adequate facilities for thoro training in the methods of modern mining, and meeting the demands for a mining education, not only from young men who are residents of New Mexico, but from students from other parts of the country desiring to avail themselves of the peculiar advantages of this region.

During the entire period of his training, the fact is impressed

upon the student that intelligent mining is strictly a business operation, that mining is today as capable of being put on a secure business foundation as any manufacturing enterprises; that, from start to finish, it is a proposition akin to all the great business workings, such as enable the railroad train or the ocean liner to run with certainty and dispatch; that, while "lucky finds" will continue to be made, mining as a business is no longer a vast lottery, ever developing to their fullest extent the gambling propensities of mankind.

During the past quarter of a century, the development of the mineral wealth of the nation has been phenomenal and the calls for adequately prepared young men to direct mining enterprises in all their various ramifications have been rapidly increasing.

ADVANTAGES.

Several features contribute to the success of this institution as a school of mines.

The unique natural surroundings of the School, already described, create an invigorating mining atmosphere which is entirely wanting in situations away from the mines and mountains.

In the the training offered by the School, there is noteworthy concentration of effort. There are many advantages in the direction of effort along few lines. In contrast with the many diversions that necessarily exist in most technical institutions of learning, where all practical branches are equally represented, singleness of purpose is a leading feature in the New Mexico School of Mines. The conservation of energy growing out of the special method of instruction, happily adapts the student so that he gets the most out of his efforts.

The student is required as an integral part of his course, to visit and critically inspect under the direct supervision of his instructors, various plants and works, and to make intelligent reports. Being obliged from the start to make the most of the exceptional opportunities presented, he quickly falls into the spirit of his present and future work, and at once necessarily acquires for his chosen profession a sympathy that is seldom attained except after school days are over and after long and strenuous effort.

Being within short distances of mines and smelters, the student has the opportunity of finding regular employment during his vacation and of acquiring desirable experience in practical work.

The field for scientific research in New Mexico is unrivalled by any other mining region and the opportunities here offered are not neglected in the plan and scope of instruction. New Mexico,

so far as concerns the mountainous portion, which comprises nearly two-thirds of its area and is nearly all mineral-bearing, is perhaps less known geologically than any other section of the United States. A little study of the plateau region of the northwestern portion of the territory has been made by the United States Geological Survey, but only in a general way. No attempt has ever been made, under government auspices, to investigate closely the geological structure of New Mexico mountains such as has been carried out in the other Rocky Mountain states, or to study the conditions of New Mexican mineral deposits, as has been done in Colorado by Emmons, in Nevada by Curtis, in California by Becker, and in other states by other distinguished investigators.

It is proposed that much of the advanced professional work of the School shall be of an original nature, to the end that the graduates may be skilled, theoretically and practically, in the very probems which they, as professional men, will be called upon to solve. This work will be carried on by the advanced students, under the direction of the professors, and will involve the collection of notes, sketches, maps and specimens, and the results of directed observation in all matters relating to the sciences and arts embraced in the courses of study. The subjects for such researches in geology and mining, and in the reduction of the ores of lead, silver, gold and copper are so numerous that it is impossible to do more here than to mention the fact that the conditions of climate, drainage, water-supply and geological structure in New Mexico differ greatly from the conditions existing in other parts of the Rocky Mountains, giving rise to new problems in practice. These problems are not by any means all that deserve attention. The investigations of the ores of iron, manganese, aluminum, cobalt, nickel, tin and quicksilver, together with the beds of coal, salt, alums, building stones, mineral-paints, cement-rocks, marls, etc., will be directly in the line of the advanced laboratory work of the School, and every student who undertakes such work will be encouraged in every way possible to accomplish the best results.

ORGANIZATION.

The general management of the New Mexico School of Mines is vested in a Board of Trustees consisting of five members appointed by the Governor of the Territory with the concurrence of the Council for a term of four years. The Board of Trustees elects a president from its members and also a secretary and treasurer. The appointment of a president of the faculty of the School is also made by them.

By act of the Legislature, the maintenance of a preparatory department is required of the higher educational institutions of the Territory. The New Mexico School of Mines, therefore, is composed of the Academy and the College.

THE ACADEMY.

The requirements for admission to the Academy are the same as those for standard secondary schools. A two-year course is offered, the work therein corresponding to that of the ninth and tenth grades of the standard high school.

Especial stress is placed on work in English writing. It is being recognized that a most necessary part of a technical graduate's equipment is an ability to express himself in concise, consecutive, idiomatic language. Slovenly, inconsequential, ambiguous English in a report, a letter, an application, can readily lose a desirable position to an otherwise valuable technical man. Nowadays, men who can do must also be able to show in written language what they can do, what they are doing, or what they have done. There being in the College, at present, no space for courses of this nature, some vigorous training of the sort must be required in the preparatory years.

The courses offered in the Academy are:

FIRST YEAR—FIRST SEMESTER.

Elementary Algebra.

To the subject of simultaneous simple equations. Special drill is given in factoring.

Time: Five hours a week.

Text: Wentworth, *Elementary Algebra.*

English I.

The Merchant of Venice, Snowbound and Websters' *Bunker Hill Oration* are read and discussed in class. Some memorizing of significant passages is required. In the composition work, an attempt is made to interest the pupil at once in narrative writing, fluency and correctness of expression being sought primarily. Later in the year, the work verges into exposition. Several of the following supplementary books are read and reported upon: *Ivanhoe, Tales from Shakspere, Autobiography of Franklin, Tom Brown's School Days, Robinson Crusoe, The First Jungle Book,* and *Pilgrim's Progress.*

Time: Five forty-minute periods a week.

Text: Scott and Denny, *Elementary English Composition.*

Latin I.

The work covers approximately the first one hundred and thirty pages of the text, comprising fifty-five lessons, with readings in the "Prose Selections" at the end of the volume,

Time: Five forty-minute periods a week.

Text: Collar and Daniell, *First Year Latin.*

Physical Geography.

Wherever possible, in this course, facts obtained by actual observation are made to verify and supplement the text used. There are daily assigned observations of clouds, winds and temperature, and a study of erosion by wind and by water and of geologic formation is made in excursions to near-by arroyos and canyons. In connection with the study of stream-flow, attention is called to the great importance of forest preservation to the people of the West.

Time: Five forty-minute periods a week.

Text: Tarr, *Elementary Physical Geography.*

FIRST YEAR—SECOND SEMESTER.

Elementary Algebra.

The first semester's work is continued thru the subject of quadratic equations. Special attention is given to the statement of problems and to the solution of literal equations.

Time: Five hours a week.

English I.

A continuation of the first semester's work in this subject. *As You Like It,* Burrough's *Sharp Eyes* and Bryant's *Sella* and *Thanatopsis* are read and discussed in class. The remainder of the supplementary books previously named are read and reported upon.

Time: Five forty-minute periods a week.

Latin I.

The text begun in the first semester is completed and thoroly reviewed; the "Prose Selections" are finished and re-read.

Time: Five forty-minute periods a week.

Botany.

Plants, shrubs and flowers of the surrounding country are studied and analyzed. The evolutionary and interrelating aspect of plant life is presented.

Time: Five forty-minute periods a week.

Text: Coulter, *Text-Book of Botany.*

SECOND YEAR—FIRST SEMESTER.

Elements of Geometry.

The first three books of the text are completed. Nearly one-half of the time is devoted to the solution of original exercises in demonstration, construction and computation.

Prerequisite: Elementary Algebra.

Time: Five hours a week.

Text: Durell, *Plane and Solid Geometry.*

English II.

Julius Caesar, The Letters of Washington and *The Rime of the Ancient Mariner* are studied in class. The same plan is pursued in the writing work as in English I. Several of the following supplementary book are read: *David Copperfield, Silas Marner, Tale of Two Cities, Hoosier Schoolmaster, Last of the Mohicans* and *Vicar of Wakefield.*

Prerequisite: English I.

Time: Five forty-minute periods a week.

Text: Scott and Denny, *Composition-Literature.*

Latin II.

The reading done for the year is represented in amount by somewhat over four books of Caesar's Gallic War. This reading may be varied by substitution of some other author, such as Nepos, for part of the year, for the sake of interest and enlarged vocabulary. In this semester, Latin equalling in amount Book I of the Gallic War and twenty chapters of Book II are read.

Prerequisite: Latin I.

Time: Five forty-minute periods a week.

Text: Caesar, *Gallic War*, (Kelsey.)

Zoology.

This study is taken up ecologically, beginning with the microscopic study of the protozoa of water and advancing to mammalia. Altho this evolutionary aspect of animal life is stressed thruout, an attempt is made to interest the student in the activities of separate forms, especially where these seem to verge on the human in intelligence. Frequent dissections are made in class, and considerable free-hand drawing of these results is required.

Time: Five forty-minute periods a week.

Text: Jordan and Kellogg, *Animal Life.*

SECOND YEAR—SECOND SEMESTER.

Elements of Geometry.

The remaining books of the text, including Solid Geometry, are completed.

Time: Five hours a week.

English II.

Henry V, *The Idylls of the King* and the minor poems of Milton are studied in class. The remainder of the supplementary books previously named are read and reported upon.

Time: Five forty-minute periods a week.

Latin II.

Should the reading be entirely in Caesar, it would cover eight additional chapters of Book II, nine chapters of Book III, thirty-six of Book IV, twenty-three of Book V and thirteen of Book VI.

Time: Five forty-minute periods a week.

History.

A study of the history of Western Europe since the barbarian invasions, with emphasis on the bearing of old-world events upon the history of the Americas. In the study of such things as the mediaeval town, life in the feudal castle, and the Renascence, an attempt is made to cause the student to realize these things as aspects of the daily existence of common men and women, which he would have lived likewise under like conditions, rather than to obtain a fixed mental chronology of dates and occurrences.

Time: Five forty-minute periods a week.

Text: Robinson, *History of Western Europe.*

THE COLLEGE.

The Requirements for Admission.

Candidates for admission to the College must show, either by examination or by the presentation of statements from schools of recognized standing, a satisfactory degree of proficiency in those subjects required in the Academy or in other subjects which are accepted as equivalent to the Academy subjects.

Registration.

No student will be permitted to register for any subject whose pre-requisites are not credited to him on the records of this school. Therefore students are advised not to delay either in making up

any deficiencies which may exist or in obtaining, from this school, credits which may be due him for work done elsewhere.

Advanced Standing.

Credits for courses required in the College will be given to students either upon their passing an examination in such courses or upon their presentation of a certificate from an approved educational institution showing that they have satisfactorily completed such courses; provided that no more than the first two years of the curriculum be thus credited to a student who has not yet received the bachelor's degree, and provided that no more than the first three years of the curriculum be thus credited to a student who has not yet received the engineer's degree. Certificates of credit for such courses must be presented, or examinations for credits must be arranged for, at or before the time of matriculation.

Irregular Students.

Students who are irregular but who intend to graduate will be required to complete the courses in which they are delinquent as soon as possible and to become regular. It cannot be urged too strongly that students expecting to matriculate with this institution come prepared to take up the work without conditions. Every candidate for admission to the school may rest assured that after entrance his time will be fully occupied.

Special Courses.

Students not intending to graduate, but desiring to take special courses, may be registered for such courses; provided they give evidence of proficiency in the prerequisite subjects and provided their acceptance into such courses does not necessitate an unsatisfactory schedule of classes.

Curricula.

The curricula of the College are planned especially to meet the needs of students intending to engage in mining or metallurgical industries, in mine-experting or in surveying mines and mining lands. Accordingly, curricula are offered in the following:

Mining Engineering.

Metallurgical Engineering.

Mining Geology.

Civil Engineering.

Each curriculum covers four years. Upon the satisfactory completion of the courses of the first three years, the bachelor's degree

is given; and at the end of the year following (the fourth year) the engineer's degree is conferred.

In the adjustment of the courses of the several curricula, it is assumed that one hour's work in the class-room requires two hours of preparation, and therefore that one hour's work in the class-room is equivalent to three hour's work in the field or in the laboratory. In the following outlined statement of curricula, the number of hours per week required in the class-room (C. R.) and in the field or in the laboratory (F. & L.) are given separately. The number of hours required in the field or in the laboratory represents *average* time however, inasmuch as it is frequently advantageous, especially for field-work, to concentrate into one week an amount of work equal to that which would require two or more weeks if performed in separate installments.

MINING ENGINEERING.

MINING ENGINEERING.

FIRST YEAR.

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	First Semester. F. & L.	Second Semester. C. R.	Second Semester. F. & L.
I. 3.	College Algebra	4		4	
I. 4.	Trigonometry	4			
I. 5.	Analytical Geometry			4	
III. 1, 2.	General Chemistry	4	6	3	
III. 3.	Qualitative Chemical Analysis			1	6
V. 1.	Free-hand Drawing		3		
V. 2.	Mechanical Drawing and Lettering		4		4
V. 3.	Descriptive Geometry	3			
V. 4.	General Surveying			3	4
VI. 1.	Principles of Geology	2	4	2	4
IV. 1.	Spanish (or German or French)	2½		2½	

MINING ENGINEERING.

SECOND YEAR.

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	First Semester. F. & L.	Second Semester. C. R.	Second Semester. F. & L.
I. 6.	Calculus	4		4	
II. 1. 2.	General Physics	5	2	4	
II. 3	Machine Drawing				2
II. 5.	Power and Power Transmission			3	
II. 6.	Engine Laboratory				1
III. 4.	Quantitative Chemical Analysis	2	6		
V. 5.	Topographical Surveying		2		
V. 6.	Plotting Surveys				2
V. 7.	Mine Surveying	2	4		
VI. 2. 3.	Mineralogy	2	3	2	3
VIII. 1.	Fire Assaying			1	8
IV. 2.	Spanish (or German or French)	2½		2½	

MINING ENGINEERING.

THIRD YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK.			
			First Semester.		Second Semester.	
			C. R.	F. & L.	C. R.	F. & L.
II.	4.	Machine Design........			2	4
II.	7.	Analytical Mechanics...............	5			
II.	8.	Hydraulics	4			
III.	5.	Wet Assaying......................		6		
III	6. 7.	Fuel and Water Analysis			1	6
V.	13.	Stresses.......................			3	
VI.	6.	Economic Geology, A..............	3		3	
VI.	7.	Economic Geology, B			2	
VI.	8.	Lithology...................... ...	2	3		
VII.	1.	Mining Methods.....................			4	
VII.	3.	Inspection of Mining Methods				5
VII.	4.	Ore Dressing...............			3	
VIII.	2.	General Metallurgy..................	3			
VIII.	9.	Metallurgical Laboratory...	1	8		

MINING ENGINEERING.

FOURTH YEAR.

Course Numbers		COURSES.	HOURS PER WEEK. First Semester. C. R.	First Semester. F. & L	Second Semester. C. R.	Second Semester. F. & L
V.	10.	Masonry Construction			3	
V.	14.	Graphical Statics			3	5
V.	15.	Structural Details, A	2	6	2	6
V.	18.	Contracts and Specifications	2			
VI.	14.	Ore Deposits	2			
VII.	2.	Mining Methods	4			
VII.	5.	Ore Dressing Plant Design		4		
VII	6.	Mine Plant	3		3	
VII.	7.	Mine Plant Design		6		6
VII.	8.	Mine Administration and Accounts	2			
VII.	9.	Mining Law	½			
VII.	10.	Mine Examination		10		
VIII.	6.	Metallurgy of Iron	2			
		Thesis				25

METALLURGICAL ENGINEERING.

METALLURGICAL ENGINEERING.

SECOND YEAR.*

Course Numbers.		COURSES.	Hours per Week. First Semester. C. R.	First Semester. F. & L.	Second Semester. C. R.	Second Semester. F. & L.
I.	6.	Calculus	4		4	
II.	1, 2.	General Physics	5	3	4	
II.	3.	Machine Drawing				2
II.	5.	Power and Power Transmission			3	
II.	6.	Engine Laboratory				1
III.	4.	Quantitative Chemical Analysis	1	6		
VI.	2, 3.	Mineralogy	2	3	2	3
VIII.	1.	Fire Assaying			1	8
VIII.	2.	General Metallurgy	3			
IV.	2.	Spanish (or German or French)	2½		2½	

METALLURGICAL ENGINEERING.

THIRD YEAR.

Course Numbers.		COURSES.	Hours per Week. First Semester. C. R.	First Semester. F. & L.	Second Semester. C. R.	Second Semester. F. & L.
II.	4.	Machine Design			2	4
II.	7.	Analytical Mechanics	5			
II.	8.	Hydraulics	4			
III.	5,	Wet Assaying		6		
III.	6, 7.	Fuel and Water Analysis			1	6
III	8.	Iron and Steel Analysis		6		
V.	13.	Stresses			3	
VI.	6.	Economic Geology, A	3		3	
VII.	1.	Mining Methods			4	
VII.	4.	Ore Dressing			3	
VIII.	3.	Metallurgy of Lead			2	
VIII.	4 or 6.	Metallurgy of Copper (or Iron)	2			
VIII.	5.	Metallurgy of Gold and Silver			2	
VIII.	9.	Metallurgical Laboratory	1	8		

* The courses of the first year are the same as those of the first year of Mining Engineering.

METALLURGICAL ENGINEERING.

FOURTH YEAR.

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	First Semester. F. & L.	Second Semester. C. R.	Second Semester. F. & L.
V. 14.	Graphical Statics			3	5
V. 15.	Structural Details, A	2	6	2	6
V. 18.	Contracts and Specifications	2			
VI. 14.	Ore Deposits	2			
VII. 2.	Mining Methods	4			
VII. 5.	Ore-Dressing Plant Design		4		
VII. 6.	Mine Plant	3		3	
VII. 8.	Mine Administration and Accounts	2			
VIII. 4 or 6.	Metallurgy of Copper or of Iron	2			
VIII. 7.	Metallurgical Inspection		10		
VIII. 8.	Metallurgical Design		6		6
	Thesis				25

MINING GEOLOGY.

MINING GEOLOGY.

SECOND YEAR.*

Course Numbers.	COURSES.	HOURS PER WEEK. First Semester. C. R.	First Semester. F. & L.	Second Semester. C. R.	Second Semester. F. & L.
II. 1, 2.	General Physics	5	3	4	
II. 5.	Power and Power Transmission			3	
II. 6	Engine Laboratory				1
III. 4	Quantitative Chemical Analysis	2	6		
V. 5.	Topographical Surveying		2		
V. 6.	Plotting Surveys				2
V. 7.	Mine Surveying	2	4		
VI. 2, 3.	Mineralogy	2	3	2	3
VI. 4.	Historical Geology			3	3
VI. 5.	Geological Mapping	1	4		
VIII. 1.	Fire Assaying			1	8
IV. 2.	Spanish	2½		2⅓	

* The courses of the first year are the same as those of the first year in Mining Engineering.

MINING GEOLOGY.

THIRD YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK. First Semester C. R.	F. & L.	Second Semester. C. R.	F. & L.
III.	5.	Wet Assaying		6		
III.	6, 7.	Fuel and Water Analysis			1	6
VI.	6.	Economic Geology, A	4		3	
VI.	7.	Economic Geology, B			2	
VI.	8.	Lithology	2	3		
VI.	9.	Structural and Dynamic Geology	3			
VI.	10.	Geological Surveying, A	1	8	1	8
VI.	12.	Petrography			2	4
VI.	13.	Topographical Mapping	1	6		
VII.	1.	Mining Methods			4	
VII.	3.	Inspection of Mining Methods				3
VII.	4.	Ore Dressing			3	
VIII.	2.	General Metallurgy	3			

MINING GEOLOGY.

FOURTH YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK. First Semester. C. R.	F. & L.	Second Semester. C. R.	F. & L.
VI.	11.	Geological Surveying, B	2	8	2	8
VI.	14.	Ore Deposits	2			
VI.	15	Paleontology	2	2	2	3
VI.	16.	Special Problems	2	12		
VII.	2.	Mining Methods	4			
VII.	9.	Mining Law	½			
VII.	10.	Mine Examination		10		
		Collateral Reading		5		5
		Thesis			2	25

CIVIL ENGINEERING.

CIVIL ENGINEERING.

SECOND YEAR. *

Course Numbers.		COURSES.	HOURS PER WEEK.			
			First Semester.		Second Semester.	
			C. R.	F. & L	C. R.	F & L.
I.	6.	Calculus	4		4	
I.	7.	Mathematical Astronomy	3			
II.	1, 2.	General Physics	5	3	4	
III.	4.	Quantitative Chemical Analysis	1	6		
V.	5.	Topographical Surveying		2		
V.	6.	Plotting Surveys				2
V.	7.	Mine Surveying	2	4		
V.	8.	Railway Surveying			3	6
V.	9.	Roads and Pavements			2	
V.	10.	Masonry Construction			3	
VI.	2. 3.	Mineralogy	2	3	2	2
IV.	2.	Spanish (or German or French)	2½		2½	

* The courses of the first year are the same as those of the first year of Mining Engineering.

CIVIL ENGINEERING.

THIRD YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK.			
			First Semester.		Second Semester.	
			C. R.	F. & L.	C. R.	F. & L.
I.	8.	Method of Least Squares..	2			
II.	7.	Analytical Mechanics...............	5			
II.	8.	Hydraulics..........................	4			
III.	6. 7.	Fuel and Water Analysis...........			1	6
III.	8.	Iron and Steel Analysis.............		6		
V.	11.	Sanitary Engineering..............	2			
V.	12.	Railway Location...................			3	
V.	13.	Stresses............................			3	
V.	14.	Graphical Statics..................			3	5
V.	19.	Water Supply.............			3	
VIII.	6.	Metallurgy of Iron..................	2			
		Spanish (German or French).......	2½		2½	

CIVIL ENGINEERING.

(Structural Engineering.)
FOURTH YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK.			
			First Semester.		Second Semester.	
			C. R.	F. & L.	C. R.	F. & L.
I.	9.	Geodesy.........			5	3
II.	5.	Power and Power Transmission....			3	
V.	15.	Structural Details, A...............	2	6	2	6
V.	16.	Structural Details, B...............	2	9	2	9
V.	17.	Concrete Structures...............	5			
V.	18.	Contracts and Specifications.......	2			
V.	20.	Sewerage and Drainage	3			
		Collateral Reading		18		6
		Thesis				15

CIVIL ENGINEERING.

(Hydraulic and Irrigation Engineering.)

FOURTH YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK.			
			First Semester.		Second Semester.	
			C. R.	F. & L.	C. R.	F. & L.
I.	9.	Geodesy			5	3
II.	5.	Power and Power Transmission			3	
V.	15.	Structural Details, A	2	6	2	6
V.	17.	Concrete Structures	5			
V.	18.	Contracts and Specifications	2			
V.	20.	Sewerage and Drainage	3			
V.	21.	Irrigation Engineering	3			
V.	22.	Hydraulic and Masonry Design	1	6	1	6
V.	23.	Irrigation Structures			2	
		Collateral Reading		15		6
		Thesis				15

CIVIL ENGINEERING.

(Sanitary Engineering.)

FOURTH YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK.			
			First Semester.		Second Semester.	
			C. R.	F. & L.	C. R.	F. & L.
I.	9.	Geodesy			5	3
II.	5.	Power and Power Transmission			3	
V.	15.	Structural Details, A	2	6	2	6
V.	17.	Concrete Structures	5			
V.	18.	Contracts and Specifications	2			
V.	20.	Sewerage and Drainage	3			
V.	22.	Hydraulic and Masonry Design	1	6	1	6
		Collateral Reading		24		12
		Thesis				15

DEPARTMENTS OF INSTRUCTION.

I. DEPARTMENT OF MATHEMATICS.

WILLIAM L. RICHER, Professor.

Constituting as they do, the foundation of the several curricula offered by the School, the various subjects in mathematics are given first attention. The instruction has a double purpose: to cultivate in the student the faculty of independent reasoning, by practice in the development of formulas and the solution of problems: to make him familiar with the applications of mathematical principles to the solution of such practical problems as may confront him in his professional career.

The first year's work in the College assumes that the student has satisfactorily completed Courses 1 and 2 of this department. Students who have not completed these courses may pursue them in the Academy, but, on account of the number and sequence of the mathematical subjects required in the College, they are strongly urged to come prepared in the two subjects referred to.

1. Elementary Algebra.

The description of this course is given on page 14.

2. Elements of Geometry.

The description of this course is given on page 15.

3. College Algebra.

Quadratic equations, fractional and negative indices, imaginary and complex quantities, the progressions and other simple series, inequalities and limits, permutations and combinations, binominal theorem for any index, undetermined coefficients, exponentials and logarithms, and elements of the theory of equations.

Prerequisite: Course 1 of this department.

Time: Class-room, four hours a week, one year.

Text: Wentworth, *College Algebra.*

4. Trigonometry.

A combination of the ratio and line systems is used, special attention is given to the transformation of trigonometric expressions, solutions of trigonometric equations, and rigorous dealing with the fundamental series of trigonometry. Spherical trigonometry

is also studied, the solution of spherical triangles and the application of spherical trigonometry to the simple problems of spherical astronomy being included.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, four hours a week, first semester.

Text: Phillips and Strong, *Elements of Plane and Spherical Trigonometry.*

5. Analytic Geometry.

The analytic geometry of the straight line, the circle, and the conic sections is covered. The course includes also the transformation of co-ordinates, a discussion of the general equation of the second degree, and an introduction to the analytic geometry of space.

Prerequisite: Course 4 of this department.

Time: Class-room, four hours a week, second semester.

Text: Ashton, *Plane and Solid Analytic Geometry.*

6. Calculus.

The subjects treated are the development of the basic principles, and formulæ of the calculus; differentation of functions, development of functions into series, evaluation of indeterminate forms; maxima and minima, lengths of curves, areas, volumes and centers of gravity. Special attention is given to the applications of the methods of differentiation and integration to problems in geometry and mechanics.

Prerequisites: Courses 3, 4 and 5 of this department.

Time: Class-room, four hours a week, one year.

Text: Osborne, *Differential and Integral Calculus.*

7. Mathematical Astronomy.

This course is intended to give the student practical knowledge of those principles of astronomy which are the foundation of geodesy. It comprises discussions of the sun, planets, satellites and stars, of their apparent motions and of the determination of their positions in the celestial sphere. Astronomical instruments, the sextant, transit, zenith-telescope, altazimuth, their adjustments and uses, are explained. Special attention is given to the methods of determining latitude, time and azimuth.

Prerequisites: Courses 2, 3 and 4 of this department.

Time: Class-room, three hours a week, first semester.

Text: Barlow, *Mathematical Astronomy.*

8. Method of Least Squares.

Observation errors and the determination of true value from numerous observations; residuals, weights, normal equations for determining average value; conditional observations, probable error, interpolation formulas.

Prerequisite: Course 6 of this department.

Time: Class-room, two hours a week, first semester.

Text: Johnson, *Least Squares.*

9. Geodesy.

The Earth, planets, satellites and stars, their astronomical positions and apparent motions, computation of right ascension and declination, description, adjustment and use of the sextant, astronomical transit, zenith-telescope and azimuth, and their applications to the determination of time and terrestrial latitude, longitude and azimuth.

Prerequisites: Courses 7 and 8 of this department.

Time: Class-room, five hours a week, second semester.
Field, three hours a week, second semester.

Text: Hayford, *Geodetic Astronomy.*

II. DEPARTMENT OF PHYSICS AND MECHANICS.

REINOLD V. SMITH, Professor.

1. General Physics.

Mechanics, molecular physics and heat are studied.

The class work consists of lectures, demonstrations, recitations and the solution of assigned problems.

The laboratory-work is so arranged as to exemplify the principles discussed in class and is quantitative in character, the qualitative experiments being performed in the class-room. The laboratory work consists of the following experiments: (1) Uniformly acelerated motion; (2) Relation of force to mass and to acceleration; (3) Composition and resolution of forces; (4) Moments; (5) Energy and efficiency; (6) Inelastic impact; (7) Elastic impact; (8) Young's modulus; (9) Moments of torsion and coefficients of rigidity; (10) Moment of inertia; (11) Simple harmonic motion; (12) Centripetal force; (13) Pressure-expansion of gases; (14) Heat-expansion of gases; (15) Archimedes's principle; (16) Calorimetry.

This course is intended not only to familiarize the student with the manner of making accurate determinations, of properly manipulating and adjusting the instruments used in making precise measurements, and of intelligently recording, interpreting and reducing the data obtained, but also to give him a better understanding of the laws of physics and of the real significance of physical constants.

Prerequisite: Course 4 of Department I.

Time: Class-room, five hours a week, first semester.
Laboratory, three hours a week, first semester.

Texts: Millikan, *Mechanics, Molecular Physics and Heat.*
Merrill, *Elementary Mechanics.*

2. General Physics.

A continuation of Course 1. Sound, light, electricity and magnetism are studied.

Prerequisite: Course 1 of this department.

Time: Class-room, four hours a week, second semester.

Text: Millikan, *Electricity, Sound and Light.*

3. Machine Drawing.

A course to supplement the courses in mechanical drawing and descriptive geometry. The elements of these subjects are applied in making working drawings of screws, nuts, bolts, keys and cotters, gibs, couplings and other component parts of machines as well as drawings of the assembled machines themselves. The lettering and dimensioning of drawings according to the most approved modern practice is given careful attention, the aim being to enable the student to read working drawings in preparation for his study of the design of machinery.

Prerequisites: Courses 1 and 2 of Department V.
Time: Laboratory, two hours a week, first semester.
Text: Anthony, *Machine Drawing.*

4. Machine Design.

A study of the design of machine-elements and modern machines. Problems involving calculations of strength of various parts of machines and the adaptation of materials to the design are assigned. Lectures and recitations are carried on, Unwin's *Machine Design,* Part I, being used as a reference. In the draughting-room, the problems taken up in the lectures are made the subject of draughting-work.

Prerequisites: Course 3 of this department, Course 7 preceding or accompanying.
Time: Class-room, two hours a week, second semester.
Laboratory, four hours a week, second semester.
Text: Low and Bevis, *Manual of Machine Drawing and Design.*

5. Power and Power Transmission.

The various sources of power are discussed briefly, steam and other heat engines as the great sources of power being studied in considerable detail; the boiler and furnace with their accessories; the engine with its connections and controlling mechanism.

Lectures are given on the transmission of power by shafting, gearing and compressed air; water-power and electric transmission and distribution of power; the general principles of the transmission and transformation of electrical energy.

Prerequisites: Course 1 of this department.
Time: Class-room, three hours a week, second semester.
Texts: Kerr, *Power and Power Transmission.*
Hutton, *Mechanical Engineering of Power Plants.*

6. Engine Laboratory.

This course is intended to accompany Course 5 of this department. It consists of the inspection and classification of engines

from an examination of their parts; mechanisms; problems in valve-gearing and setting; measurement of engine constants, and indicated, and brake, horse-powers; indicators and diagrams; governors; cylinder and stuffing-box packing; the lining up and care of shafting; pulleys, belting, and rope-drives; the safety inspection of boilers; boiler setting and connections; testing of boiler shells, care of flues; the use of pumps and injectors.

Time: One hour a week (average), second semester.

7. Analytical Mechanics.

The mechanics of materials deals with the stresses and deformations produced in bodies of various forms and materials, by forces variously applied. First, moments of inertia and radii of gyration of plane figures and solids are treated in detail; then follow the theories of tension, compression of long and short columns, shear and torsion; flexure of beams, elastic curves and safe loads; continuous beams, the theorem of three moments and graphical solutions; introduction to graphic statics. The application of theoretical formulas to the solution of practical engineering problems is mastered by many numerical computations.

Prerequisites: Course 1 of this department and Course 6 of Department I.

Time: Class-room, 5 hours a week, first semester.

Text: Church, *Mechanics of Engineering.*

8. Hydraulics and Hydraulic Machinery.

Theoretical hydraulics, head and pressure velocity and path of a jet; instruments and measurements; practical formulæ; flow of water through orifices, weirs, tubes, pipes and open channels; losses of head, hydraulic gradient; nozzles, river-gauging, dynamic force of water; water-wheels, over-shot, breast and under-shot; turbines and impulse wheels; pumps, reciprocating and rotary, and pumping machinery.

Prerequisites: Course 2 of this department, Course 7 accompanying or preceding.

Time: Class-room, four hours a week, first semester.

Text: Merriman, *Treatise on Hydraulics.*

III. DEPARTMENT OF CHEMISTRY.

ROBERT PEELLE NOBLE, Professor.

E. N. HOBART, Laboratory Assistant.

The excellent equipment of the chemical laboratory (elsewhere described) makes it possible to offer a number of advanced courses essential to chemical engineering, in addition to those required by the curricula already outlined. These courses are designated *special* and will be given upon the request of a sufficient number of students.

It is the intention to secure as perfect a correlation as possible between the lectures, the quizzes and the laboratory-work, in order that the greatest efficiency in instruction may be attained.

1. General Chemistry, A.

This course is introductory to all engineering, metallurgical and geological courses and is intended to give the student a broad view of the field of inorganic chemistry by presenting to him the fundamental laws and theories of chemistry and by acquainting him with the occurrence, preparation, properties, relations and uses of the common non-metallic elements and of their compounds. With these substances, he performs in the laboratory as many experiments as the time permits, great weight being given to the making of neat and accurate records of these experiments and to the attainment of a scientific view-point. The time in the class-room is largely devoted to quizzes upon assigned subjects, ample opportunity thus being given to correct any erroneous ideas possessed by the student, and to add to his information on these subjects.

It is very desirable that one should be prepared with elementary physics before entering upon this course.

Prerequisite: Course 1 of Department I.

Time: Class-room, four hours a week, first semester.
Laboratory, six hours a week, first semester.

Texts: Noble, *Elementary Chemical Theory.*
Newth, *Inorganic Chemistry.*

2. General Chemistry, B.

This is a continuation of the preceding course and comprises a study of the metals in the same manner as the non-metals are

studied in Course 1. It is intended to be taken simultaneously with Course 3.

Prerequisite: Course 1 of this department.

Time: Class-room, three hours a week, second semester.

Text: Newth, *Inorganic Chemistry.*

3. Qualitative Analysis.

Those reactions which are used in the separation and detection of the metals of the silver group are carried out in the laboratory and discussed in the class-room. When sufficient familiarity with these reactions has been acquired, unknown solutions containing one or more metals of this group are then analyzed and the metals detected. The metals of the copper group are then studied similarly and unknown solutions containing the metals both of the silver and copper groups are analyzed. In this manner are studied the metals of all the groups and finally the acids. When entirely familiar with the analytical procedure both for metals and acids, the student is required to analyze at least one of the following substances: Alloys, insoluble salts, industrial products, minerals, slags, mattes and speisses.

Prerequisite: Course 1 of this department. Course 2 must precede or accompany.

Time: Class-room, one hour a week, second semester.
Laboratory, six hours a week second semester.

Texts: Perkin, *Qualitative Chemical Analysis.*

4. Quantitative Analysis.

A course embodying the general principles of quantitative analysis and introductory to those courses involving special quantitative methods.

In the laboratory the following experiments are performed:

Gravimetric: Determinations of chlorin in a chlorid, of iron in iron wire or in ferrous ammonium sulphate, of sulphur in a sulphate, of phospsorus in apatite, of copper (electrolytically) in brass, of silica in feldspar.

Volumetric: The preparation of half-normal solutions of an acid and of an alkali, the determination of the strength of some acid or alkali, the determination of iron in an ore by the permanganate method, and the determination of silver in an ore by Vǒlhard's method.

The class-room work consists in lectures on the use and care of balances, crucibles and desiccators, on the selection and use of indicators, on the use, care and calibration of volumetric flasks, burettes and pipettes, on the methods used in the laboratory from

the standpoint of modern chemical theories, in quizzes on these topics and in the solution of stoichiometric problems involving calculations which are similar to those arising from, and essential to, the laboratory experiments.

Prerequisites: Courses 1, 2 and 3, of this department.

Time: Class-room, two hours a week, first semester.
Laboratory, six hours a week, first semester.

Texts: Talbot, *Quantitative Chemical Analysis.*
Fresenius, *Quantitative Chemical Analysis.*

5. Wet Assaying.

A thoroly practical course in the determination of the important constituents of ores and metallurgical products. The methods taught are those in use in the large smelters of the west. The student works upon checked samples of widely varying composition until he becomes familiar with the various methods and can carry them out under all conditions with accuracy and rapidity.

A large collection of accurately checked samples are available for analysis, including many obtained from the principal smelters of the country. The regular work of the course consists in the assaying of typical ores and metallurgical products. By putting in extra time the ambitious student may greatly increase the number of his determinations and thus become decidedly more expert in this work.

The following determinations are made: arsenic, silver, copper (both by the cyanid and iodid methods), lead by the molybdate method, zinc by the ferrocyanid method, manganese and calcium by the permanganate method.

Prerequisites: Course 4 of this department.

Time: Laboratory, six hours a week, first semester.

Texts: Low, *Technical Methods of Ore Analysis.*
Sutton, *Volumetric Analysis.*

6 Fuel Analysis.

Analyses of various coals or of other fuels are made and their heat-values are then calculated from these analyses and also determined experimentally by means of the calorimeter. Flue-gases are analyzed and the results are interpreted. The flash-point, burning point, specific gravity, viscosity, and acidity of oils are determined.

Lectures on the methods required for these determinations are given in the class-room.

Prerequisite: Course 4 of this department.

Time: Class-room, one hour a week first twelve weeks of second semester.

Laboratory, six hours a week, seven weeks of second semester.

Texts: Stillman, *Engineering Chemistry.*

Hempel, *Gas Analysis.*

7. Water Analysis.

Analyses of waters are made in regard to their possible use in boilers. These analyses involve determinations of total solids, organic and volatile matter, silica, aluminum and iron, calcium, magnesium, sodium and potassium, and carbonic, sulphuric and hydrochloric acids.

Lectures are given on the methods required for these determinations, on the injurious action of certain waters on boilers and on the prevention of such action.

Prerequisite: Course 4 of this department.

Time: Class-room, one hour a week, last five weeks of second semester.

Laboratory, last ten weeks of second semester.

Texts: Stillman, *Engineering Chemistry.*

Fresenius, *Quantitative Chemical Analysis.*

8. Iron and Steel Analysis.

The analysis of pig-iron, wrought iron and steel is undertaken, both accurate methods and rapid methods being considered. As many determinations of the following substances are made as the time permits; iron, sulphur, silicon, phosphorus, manganese, carbon both graphitic and combined, titanium, nickel, cobalt, chromium, aluminum and arsenic.

Prerequisite: Course 4 of his department.

Time: Laboratory, six hours a week, first semester.

Text: Blair, *Chemical Analysis of Iron.*

9. Inorganic Preparations. (*Special.*)

Chemically pure substances of commercial importance are prepared by the student with constant attention to the securing of maximum yields. Skill in manipulation is encouraged, methods of manipulation not occurring in other courses are practiced, and a general increased knowledge of inorganic chemistry is acquired.

Prerequisite: Course 4 of this department.

Time: Class-room, one hour a week, one semester.

Laboratory, six hours a week, one semester.

Text: Lengfeld, *Inorganic Preparations.*

10. Industrial Inorganic Chemistry. (*Special.*)

The utilization of inorganic materials in manufacturing processes was taken up in an elementary way in connection with general chemistry. This special industrial course goes into the subject considerably more in detail. The manufacturing processes considered are mainly those of acids, alkalies, mineral dyes, mineral paints, explosives and matches.

The aim is to expound the dominant principles underlying each process rather than to present such an account of the details as will suffice for the student of any particular industry. In this manner, the student is prepared to study efficiently the literature of any branch in which he may afterwards become especially interested.

Prerequisites: Courses 1 and 2 of this department.
Time: Class-room, two hours a week, one semester.
Text: Thorp, *Outlines of Industrial Chemistry.*

11. Organic Chemistry. (*Special.*)

This course serves as an introduction to the study of the hydrocarbons of both the fatty and the aromatic series, alcohols, phenols, aldehydes, organic acids, ethers, esters, and carbohydrates. Their formation, relations, and derivatives are discussed, and special attention is given to the explanation of familiar organic phenomena.

Prerequisites: Courses 1 and 2 of this department.
Time: Class-room, two hours a week, one year.
Laboratory, six hours a week, one year.
Texts: Remsen, *Organic Chemistry.*
Fischer, *Prepartion of Organic Compounds.*

12. Industrial Organic Chemistry. (*Special.*)

The utilization of organic materials in the industrial arts is considered. The subjects taken up are: Petroleum and minerals oils, fats and fatty oils, essential oils and resins, cane-sugar, starch and its alteration products, fermentation, milk, vegetable textile fibres, animal textile fibres, animal tissues and their products, destructive distillation, artificial dyes, bleaching, dyeing and textile printing.

Special prominence is given to the petroleum and mineral oil industry, and to the destructive distillation of coal. The topics discussed under the first head are natural gas and its products, illuminating gas, fuel gas, lamp-black, and electric light carbons, crude petroleum and its products, ozokerite and natural paraffines and their products, bitumens, asphalts, bituminous shales and their products, and vaseline. Under the destructive distillation of coal

are taken up the varieties of coal, distillation in the gas-retort and in the coke-ovens, fractional separation of crude coal-tar, treatment of the ammoniacal liquor, light oil, middle oil, heavy oil, anthracene, pitch, and gas.

Prerequisites: Courses 1, 2 and 11 of this department.

Time: Class-room, two hours a week, one semester.

Text: Thorp, *Outlines of Industrial Chemistry.*

13 **Physical and Theoretical Chemistry.** (*Special.*)

The elements of theoretical chemistry have already been studied in the courses in general chemistry, qualitative and qauntitative analysis. The subject is here pursued more exhaustively. The principal subjects considered are: The gas laws, atomic and molecular weights and the methods of determining them, forms and the phase rule, the kinetic theory, thermochemistry, ionization, dissociation and balanced actions, electro-chemistry and photochemistry.

Prerequisite: Course 4 of this department.

Time: Class-room, two hours a week, one semester.

Text: Walker, *Physical Chemistry.*

IV. DEPARTMENT OF LANGUAGES.

Emmet Addis Drake, Professor.

A speaking knowledge of Spanish has recently become a great advantage, if not a necessity, to a large percentage of the young men who engaged in any of the lines of work for which they may fit themselves at the School of Mines. For that reason special attention is given to the study of the language at this institution. The course offered continues thru two years and is designed to give the student a practical speaking knowledge of Spanish. The location of the New Mexico School of Mines affords an unsurpassed opportunity for acquiring this knowledge; for, in Socorro and vicinity, Spanish is as generally spoken as English.

Either French or German may be taken in place of Spanish if a sufficient number of students apply.

The courses in German continue thru two years. No particular attention is given to the speaking or writing of this language. The chief aim is to put the student into possession of a useful instrument for his major line of work.

The importance of a reading knowledge of both German and French cannot be emphaszied too strongly, as a vast store of information necessary to the engineer and scientist is locked up in these languages. By the end of the second year the student should be able to read readily the scientific and technical books which are of use to him in his work.

The courses offered in French continue thru two years. The chief aim in this course, as in the course in German, is to give the student such a reading knowledge of the language as will be of practical use to him in the pursuit of his special line of work. At the end of the course, the student is expected to be able to read French with sufficient ease to use French text-books and other publications in the pursuit of his technical studies.

1. Spanish.

The work is based on Worman's First and Second Spanish Readers. A part of the class exercises each day consists in cross-translations, both oral and written. Special stress is placed upon conversational exercises. Attention is given to the elementary principles of the grammar of the language, especially to conjugation.

Time: Two and a half hours a week, one year.
Texts: Worman, *First and Second Spanish Readers.*
Garner, *Spanish Grammar.*

2 **Spanish.**

Alarcon's *El Capitan Veneno,* and Valera's *El Pajaro Verde* are read. The study of Spanish grammar is pursued systematically, Garner's *Spanish Grammar,* being used as a text. Two periods each week are devoted to conversation in Spanish and to cross-translation, no particular text-book being used in this work.

Prerequisite: Course 1 of this department.

Time: Two and a half hours a week, one year.

3. **German.**

The first year's work in this course is elementary. It consists of study of grammar and easy readings. Practice in speaking and writing the language is not insisted upon any further than is needed in fixing the main principles of construction in the mind.

Time: Two and a half hours a week, one year.

4. **German.**

The second year's work in German consists in the reading of narrative and descriptive modern prose and a drama of Lessing or Schiller. The study of grammar is continued. Sight-reading forms a large part of the exercises of the second term. The reading texts are changed from year to year to avoid repetition and to give students who may desire an opportunity to take more than the required amount of German.

Time: Two and a half hours a week, one year.

5. **French.**

The first year's work is elementary. Fraser and Squair *French Grammar* and *Le Roman d'un Jeune Homme Pauvre* form the basis of the work. The text-book for reading is changed from year to year, however, to give students who may wish it an opportunity to read more than the required amount of French. Easy readings are assigned for work outside the class-room with a view to examination.

Time: Two and a half hours a week, one year.

6. **French.**

Effort is still concentrated upon reading. The student is expected to be able at the end of this course to read with sufficient ease to make practical use of French text-books and periodicals in his other studies. The study of grammar is continued. *La Petite*

Fadette, Le Cid, Le Misanthrope and *Athalie* are the texts from which the readings are selected.

Time: Two and a half hours a week, one year.

V. DEPARTMENT OF CIVIL ENGINEERING.

George F. Eckhard, Professor.

In Civil Engineering, the first three years are devoted to the mastery of those sciences upon which all professional engineering practice is based. In addition to a thoro mathematical training, particular care is taken to familiarize the student with the construction, care and use of engineering instruments. To this end, in addition to the regular class-room work, much time is given to field work, wherein a great variety of practical problems are treated. Attention is also given to the study of engineering materials and their adaptation to various structures.

In the post-graduate work of the fourth year the student is offered several branches in which he may specialize. These are Structural Engineering, Sanitary Engineering, and Hydraulic and Irrigation Engineering. The work of this year is largely drawing and design, intended to prepare the student for practice along one of these lines.

The School offers great advantages in the line of Hydraulic and Irrigation Engineering. Besides being situated in a distinctly irrigation country, it is also in reasonable proximity to two of the largest projects of the United States Reclamation Service, where the latest and best methods may be studied.

Students have usually been able to attach themselves during the summer vacation to the regular surveying parties of railway, irrigation or mining companies, the United States Land Office or the United States Geological Survey.

1 Free-Hand Drawing.

It is expected that, during the first year, the student will acquire considerable skill in drawing, preparatory to the special training of later years. Particular attention is given to free-hand work in order to enable the student to make, readily and rapidly, intelligent sketches of all ordinary objects, simple machines, diagrams of engineering works and geological structures. A study of light and shade and of perspective is made, and pencil-and-pen drawings from various models are executed, the proportions being obtained by making measurements of the object "pencil in hand."

Time: Three hours a week, half-hour periods, first semester.

2. Mechanical Drawing and Lettering.

This course comprises the drawing of 20 plates in the geometrical representation of objects by isometric and orthographic projections. Objects in various positions are projected orthographically and the relations between the different views are brought out; sections at different positions and the intersections of solids are represented. The principles of linear perspective are discussed and applied to the representation of some simple objects.

The latter part of the semester is devoted to special practice in lettering and in the construction of appropriate and attractive letters for maps and engineering plans.

Prerequisite: Course 2 of Department I.

Time: Laboratory, four hours a week, one year.

Text: Tracy, *Mechanical Drawing.*

3. Descriptive Geometry.

The representation of all geometrical magnitudes by means of orthographic projection, the solution of problems involving points, lines, surfaces and solids, descriptions of and problems relative to warped and double-curved surfaces, intersections of lines and surfaces.

Prerequisite: Course 2 of Department I.

Time: Class-room, three hours a week, first semester

Text: Church, *Descriptive Geometry.*

4 General Surveying.

The introductory course in surveying deals with the principles of land-surveying, the instruments used both in the field and in the office, their adjustments and their proper care. The transit, level, solar compass, and plane-table are discussed in detail and their uses in the various problems of land, mine, and hydrographic surveying are illustrated by numerous practical problems and field exercises.

In the field-practice, each student becomes thoroughly familiar with the laying out with compass and chain of small land holdings, the survey of urban lots and streets by means of transit and steel-tape, location of mining claims, and similar work. Observations are made on the polar-star for the purpose of determining the true meridian. Latitude, azimuth and time by direct solar observations are determined. Triangulation, both primary and secondary, from a measured base-line is carefully worked out. Measurements are made of mountain heights by triangulation methods. The various methods of topographic mapping are considered in detail.

Prerequisites: Courses 1, 2 and 4 of Department I.
Time: Class-room, three hours a week, second semester.
Field, four hours a week, second semester.
Text: Raymond, *Text Book of Plane Surveying.*

5. Topographical Surveying.

This course is intended to give the student thoro drill in stadia methods, especially as applied to rapid topographical surveying. The theory of the stadia is first discussed, after which a complete stadia survey of a broken area of land is made. Great stress is laid on the careful taking of notes with reference to their use in Course 6 of this department, for the study of the manner of reduction and of the most approved methods of plotting survey notes.

Prerequisite: Course 4 of this department.
Time: Field, two hours a week, first semester.

6. Plotting Surveys.

The early part of the semester is devoted to mapping general land surveys made by the student himself or from notes furnished him. Bearings or azimuths of courses are laid off both by protractor and by coordinates, and errors in closure are discussed and illustrated. In general, areas are computed by latitudes and double meridian distances, and by the method of rectangular coordinates of the corners. The topographical survey of Course 5 is plotted, all countour lines, streams, roads, fences and buildings being properly shown. The nature of the soil and vegetation is indicated by the conventional topographical symbols, thus making a complete and accurate map of the area surveyed. In plotting stadia work, special attention is given to rapid methods of reducing and plotting inclined stadia readings. The mechanical reproduction of maps to different scales and the evaluation of irregular areas are discussed.

Prerequisite: Courses 4 and 5 of this department.
Time: Laboratory, two hours a week, second semester.

7. Mine Surveying.

The work consists of lectures, field-practice and office-work. The field-practice embraces both surface location of claims and top-works, and the underground excavations.

In the location of mining claims, a complete survey is made for the purpose of patenting, in accordance with the requirements of the Surveyor General's Office. It includes all the methods followed by United States mineral surveyors. The law relating to surveys for the patenting of mining properties is treated in detail.

In the underground surveying, particular attention is given to physical difficulties met with and unusual obstacles to be overcome. Among the special topics that are dwelt upon at length are the location of underground stations, connection of surface and subterranean workings thru slopes and shafts, graphic methods of keeping notes, preparation of mine-maps by method of co-ordinates, preservation of maps and permanent records.

In the field-practice, several mines of different types are surveyed, full notes taken and maps made.

Prerequisite: Course 4 of this department.

Time: Class-room, two hours a week, first semester.
Field-practice and office-work, four hours a week, first semester.

Text: To be announced.

8. Railway Surveying.

Under this head is studied the location of a railway under the three natural divisions of Reconnoissance, Preliminary Surveys, and Location Surveys, with the methods and instruments adapted to each. The theory of economy in grades and curves is considered at some length and the principles of simple and compound curves treated.

Practice is given in locating curves and tangents, levelling, plotting, establishing grades, constructing profiles, cross-sectioning, estimating volumes of fills and cuts, location of piers and bridge-abutments, and laying out of switches.

Prerequisite: Course 4 of this department.

Time: Class-room, three hours a week, second semester.
Field, six hours a week, second semester.

Texts: Raymond, *Text-Book of Plane Surveying.*
Searle, *Field Engineering.*

9. Roads and Pavements.

A brief discussion, from an engineering standpoint, of the principles involved in highway work under the following divisions: Economic importance and characteristics of good highways, location, construction, drainage, improvement and maintenance of country roads, various paving materials, broken stone, brick, asphalt, wood and stone blocks, and concrete, foundations for and adaptability of each, arrangement and details of city streets.

Prerequisite: Course 1 of Department II.

Time: Class-room, two hours a week, second semester.

Text: Spalding, *Roads and Pavements.*

10. Masonry Construction.

The lectures treat chiefly of the following subjects:

(1) Materials used in masonry construction, under the heads of stone, brick, lime, cements, wood, iron and steel. Special emphasis is placed upon the geological occurrences of the suitable materials and methods of testing.

(2) Foundations; open trenches, pile foundations, foundations under water, cofferdams, cribs, pneumatic and other methods.

(3) Dams; brush-cribs, framed timbers, masonry and rock fills.

(4) Retaining wall, bridge abutments and bridge piers.

(5) Culverts, wood, pipe and stone arches.

Prerequisite: Course 1 of Department II.

Time: Class-room, three hours a week, second semester.

Text: Baker, *Treatise on Masonry Construction.*

11. Sanitary Engineering.

An elementary course in sanitary science dealing with the drainage of building and lands, disposal of house-sewage, water carriage systems, storm sewers; also the heating, plumbing and ventilation of buildings both public and private.

Prerequisites: Courses 1 and 8 of Department II.

Time: Class-room, two hours a week, first semester.

Text: Merriman, *Sanitary Engineering.*

12. Railway Location.

This course presents the economic phases of railway location and construction. The causes which affect the gross receipts of a road, the cost of construction and the operating expenses are fully discussed, and the relative importance of each considered in detail. True and false economy in construction, and kindred topics are entered into at length.

Prerequisite: Course 7 of Department II.

Time: Class-room, three hours a week, second semester.

Text: Wellington, *Economic Theory of Railway Location.*

13. Stresses in Frame Structures.

The application of the laws of forces in equilibrium to the computation of the stresses in various kinds of frame structures; the method of moments; the method of resolution of forces; loads on a roof truss; dead, snow, and wind loads; changes in length due to changes in the temperature; highway bridges, dead loads, moving loads, snow and wind; applications of different forms of truss; railway bridges, dead loads, moving loads; snow, wind and impact; shear and bending moment; double and multiple truss systems; de-

flection of bridges. Numerous practical problems are presented for solution.

Prerequisite: Course 7 of Department II.

Time: Class-room, three hours a week, second semester.

Text: Merriman and Jacoby, *Roofs and Bridges, Part I.*

14. Graphical Statics.

In this course the graphical methods of solving problems relating to forces in equilibrium are considered in detail. These methods are based upon the representation of forces in amount and direction by straight lines, the properties of force-polygons and equilibrium-polygons, moment and shear diagrams. Special attention is given to the application of these methods to the stresses in various framed structures.

Prerequisite: Course 1 of Department II.

Time: Class-room, three hours a week, second semester.
Laboratory, five hours a week, second semester.

Text: Merriman and Jacoby, *Roofs and Bridges, Part II.*

15. Structural Details, A.

Practical applications of the principles of stresses in the design and proportioning of the various parts of engineering structures, dams, arches, roofs, and bridges.

Special attention is given to designing long columns and to the connections of the members of a structure.

Prerequisites: Courses 13 and 14 of this department.

Time: Class-room, two hours a week, one year.
Laboratory, six hours a week, one year.

Text: Merriman and Jacoby, *Roofs and Bridges, Part III.*

16. Structural Details, B.

More advanced work in continuation of Structural Details A. in which are considered steel mill and office buildings, cantilever and draw bridges, steel arch ribs and concrete arches.

Prerequisite: Course 15 of this department.

Time: Class-room, two hours a week, one year.
Laboratory, nine hours a week, one year.

Text: Merriman and Jacoby, *Roofs and Bridges, Parts III and IV.*

17. Concrete Structures.

This course deals with the designing and construction of reinforced concrete structures, the materials used and the methods employed; the properties of concrete and steel, practical formulas for the computation of all classes of structures, illustrations and

descriptions of a large number of representative structures, properties and methods of testing the materials used, various types of reinforcement, forms, facing and finishing.

Prerequisites: Course 1 of Department II, and Course 14 of this department.

Time: Class-room, five hours a week, first semester.

Text: Buel and Hill, *Reinforced Concrete.*

18. Contracts and Specifications.

Lectures on the laws governing contracts and their special applications to engineering construction; approved forms of specifications for various structures.

Time: Class-room, two hours a week, first semester.

Text: Wait, *Law of Contracts.*
Various standard specifications for reference.

19. Water Supply.

The design, construction and maintenance of municipal water supply systems, under the following divisions; sources and requisites of water supply, methods of collecting, storage and distributing water; the flow of water in various kinds of conduits, storage reservoirs, analysis and purification of public water supplies, pumping systems, maintenance of quantity and quality of supply, maintenance of storage and distribution works, house connections, meters and waste of water.

Prerequisite: Course 8 of Department II.

Time: Class-room, three hours a week, second semester.

Text: Folwell, *Water-Supply Engineering.*

20. Sewerage and Drainage.

A study of the quantity of house-sewage and storm waters, the proper shape and dimensions of conduits for water carriage systems; sewer ventilation and flushing, office of man-holes, flush tanks and other details of construction; location of outfall, final disposal of sewage, sewage irrigation, filtration, septic treatment, cremation of refuse.

Prerequisite: Course 8 of Department II.

Time: Class-room, three hours a week, first semester.

Text: Folwell, *Sewerage.*

21. Irrigation Engineering.

The condition governing, and the extent and commercial value of the irrigation of arid lands in this and other countries, sources and requisites of a supply of water for irrigation, difficulties and harmful effects of irrigation, flow and measurement of water, duty

of water, storage, distribution and application of water, together with a brief description of the structures appropriate to each division of the process.

Prerequisite: Course 8 of Department II.

Time: Class-room, three hours a week, first semester.

Text: Wilson, *Manual of Irrigation.*

22. Hydraulic and Masonry Design.

This course is chiefly field and drawing-room work in the preparation of plans and specifications for a municipal water supply, a sewer system or an irrigation system, at the option of the student, the data on which to base the design being collected by the student himself.

Prerequisite: Courses 19, or 20, or 21 of this department should precede or accompany this course.

Time: Class-room, one hour a week, one year.
Laboratory and field, six hours a week, one year.

23. Irrigation Structures.

A detailed study of the various classes of structures necessary for the impounding, distribution and application of water for irrigation purposes, with descriptions of numerous examples of the various types of dam used (especially those used in American practice), masonry, rock and earth fills and timber cribs, storage capacity and sedimentation of reservoirs, waste-ways, diversion weirs and head works, distribution systems, canals, lined and unlined, tunnels, flumes and aqueducts, water power in connection with irrigation systems.

Prerequisite: Course 21 of this department.

Time: Class-room, two hours a week, second semester.

Texts: Schuyler, *Reservoirs for Irrigation.*
Flynn, *Irrigation Canals and other Irrigation Works.*

24. Summer Field Work.

During the summer, surveying parties will be organized for all students who desire to avail themselves of the privilege, involving four weeks of field practice in the various branches of surveying. The parties will camp in localities convenient to their respective lines of work.

When so organized, the first-year men are assigned a township of land which they subdivide in accordance with the instructions of the United States Land Office, and make a topographical map by the transit and stadia and plane-table methods. Of the upper-class men, the students of Mining Enigneering make complete sur-

veys and construct maps of important mines; while the Civil Engineering students locate a railway from five to ten miles in length, according to conditions, and also make complete surveys, maps and estimates for an irrigation system.

Each year, students are usually able to secure employment for the summer with regular surveying parties and receive encouragement in this in every way possible.

VI. DEPARTMENT OF MINING GEOLOGY.

Arthur K. Adams, Professor.

The organization of this department, having for its special purpose instruction concerning ore-bodies and their relations to geological structures, is founded on the belief that the proper knowledge of this branch of mining contributes equally as much to the success of any enterprise as a knowledge of mechanical mining methods, or what is most generally understood by mining engineering. The proper geological consideration of the materials sought after in mining vastly promotes mining, both generally and specifically by putting each proposition upon a more strictly business basis. Prospecting is more rationally conducted. Exploration is more confidently carried on. Exploitation is systematically productive. The element of chance is very largely eliminated.

For the most part, the work in these courses is laid out with reference to the mining aspects of the subject. Great importance is attached to field-work and, for this work, the facilities offered by the neighborhood are nowhere else surpassed.

1. Principles of Geology.

All of the training in geology is arranged with special reference to professional work. There are three main classes of students to which the courses have been particularly adapted. The first class embraces those whose occupations are to be closely identified with mining. A second class includes those who look forward to employment of a more or less public character, such as is afforded by private, state and federal geological surveys. A third class aims to embrace students who expect to follow, in part at least, the pure science of geology, or to be connected with the economic and technical departments of higher educational institutions.

The instruction is conducted by means of lectures, recitations, laboratory examinations and frequent excursions into the field and is designed to familiarize the student with the data of geology. The processes and conditions of geology are considered in their different aspects. The laws and methods of interpretation of phenomena are discussed with considerable detail. The mental operation of observation, generalization, suggestion of hypothesis, formulation of theory and proof of geological doctrine are explained and the

importance of properly considering them in all scientific work is emphasized.

Features illustrating a large variety of geological phenomena are well displayed in the neighborhood of the School and afford excellent opportunities for field-work. The old Socorro volcano, rising 2,500 feet above the campus, presents many types of rocks, and many structures associated with volcanic districts. Lemitar mountain, ten miles away, affords other phenomena of vulcanism. Faulting, folding, jointing and other associated features, are well displayed. The sedimentaries are well represented from the paleozoics to the most recent. The phenomena of erosion and the development of geographic forms are almost unique. With all these illustrations at the very door of the School, the student is never at a loss for something interesting and new.

Excursions are made, mines are visited and the student is instructed in the art of taking notes, and of making sketches and maps. He subsequently writes out a full but concise report of his observations, which is critically examined in all its aspects by the intructor in charge. These reports are then talked over in class, and the shortcomings noted and corrected.

An outline of the course is furnished by syllabus, with frequent reference to the principal text-books on geology.

Time: Class-room, two hours a week, one year.
Field, four hours a week, one year.

Texts: Le Conte, *Text Book of Geology.*
Geikie, *Text Book of Geology.*
Chamberlin and Salisbury, *Geology.*

2 Descriptive Mineralogy.

(a.) Crystallography. This particular division of physical mineralogy, dealing with the geometrical forms in which mineral crystallize, is thoroly studied. The different crystal systems are considered in turn and constant practice in the reading of crystal forms is given by means of a complete collection of wooden and celluloid models and also from specially selected natural crystals.

Frequent reference is made to Dana, Naumann and Miller, and the symbols used by each are mastered.

Prerequisites: Courses 3 and 4 of Department I.

Time: Class-room, two hours a week, first seven weeks of first semester.
Laboratory, three hours a week, seven weeks.

Texts: Dana, *Text Book of Mineralogy.*
Williams, *Elements of Chrystallography.*

(b.) Physical Mineralogy. The subjects of hardness, cleavage, color, specific gravity, etching and thermo-electric properties, optical characters and the like are carefully considered. The special study of optical properties and of the actions of crystals on transmitted light is deferred, however, until petrography is studied.

Prerequisite: Course 2 (a) of this department.

Time: Class-room, two hours a week, three weeks of first semester.
Laboratory, three hours a week, three weeks of first semester.

Text: Dana, *Text Book of Mineralogy.*

(c.) Blowpipe Analysis. Observations are made in the laboratory of the behavior of minerals when heated in closed and in open tubes and on charcoal. Sublimates characteristic of different elements are examined and recognized. Characteristic flame colorations are studied and also colors imparted by oxids to microcosmic-salt beads and borax beads. A few wet tests for elements are also studied.

Prerequisites: Course 2 (b) of this department and Courses 1 and 2 of Department III.

Time: Class-room, two hours a week, last seven weeks of first semester.
Laboratory, three hours a week, last seven weeks of first semester.

Texts: Dana, *Text Book of Mineralogy.*
Landauer, *Blowpipe Analysis.*
Warren, *Notes on Blowpipe Analysis.*

3. Determinative Mineralogy.

Specimens of minerals from the large collections of the School and also those collected on field excursions or sent into the laboratory are examined and identified by the student, the crystal form, the physical and chemical properties and the paragenesis of each mineral being carefully studied. Special emphasis is given to acquiring familiarity with a large number of such mineral species as occur in mining regions and with the associations in which they are likely to be found. The order of study followed in the lectures is; the elements, sulphids, selenids, arsenids, tellurids, antimonids, sulphosalts, haloids, oxids, oxygen-salts, salts of the organic acids and hydrocarbons. Much of historic interest is given in the lectures, and gems and precious stones receive considerable attention. Collateral reading is required on the important species.

Weekly quizzes, monthly reviews and other practical exercises

supplement the daily lectures and serve to broaden the student's training, as well as to fix in his memory the various distinctions between mineral species. The relative values of each mineral, both from the standpoint of economic use and its worth for mineral collctions, are clearly and fully set forth.

Prerequisites: Course 2 of this department and Courses 1 and 2 of Department III.

Time: Class-room, two hours a week, second semester.
Laboratory, three hours a week, second semester.

Texts: Dana, *Text Book of Mineralogy.*
Moses and Parsons, *Mineralogy, Crystallography and Blowpipe Analysis.*

4. Historical Geology.

The development of the North American continent with special reference to the United States is taken up to show the past geologic and geographic conditions. It embraces the stratigraphy and the general geologic structure, showing the character of the sediments at different times. Fossils, the time-markers of rocks, are introduced wherever possible and the student becomes familiar with the conditions of deposition and the fossils characteristic of different periods.

Prerequisites: Course 1 of this department.

Time: Class-room, three hours a week, second semester.
Laboratory, three hours a week, second seemster.

Texts: Le Conte, *Text Book of Geology.*
Chamberlin and Salisbury, *Geology.*
Zittel-Eastman, *Paleontology.*

5 Geological Mapping.

Each student is assigned a limited area of which he prepares a geological map. The areas are small and the map and report give detailed information as to the rocks, their character, relative age and history. Contacts are traced out and plotted, the relation of the various rocks to each other being sought and the structure of the region studied. The class-room work is devoted to discussions of questions arising in the field.

Prerequisites: Course 1 of Department VII and Course 1 of this department.

Time: Class-room, one hour a week, first semester.
Field, four hours a week, first semester.

6. Economic Geology, A.

This course embraces the study of ore deposits, first taking up the formation of open spaces, the filling of these spaces, the classification of veins and the theories of ore deposition. Different classifications of ore deposits are then discussed and examples given of each type of deposit.

In the second half of the course, the iron ores are first considered, then those of copper, gold, silver and gold, silver and lead, lead, lead and zinc, zinc, etc. The course includes lectures and much collateral reading.

Prerequisites: Courses 1, 2 and 3 of this department.

Time: Class-room, four hours a week, first semester and three hours a week second semester.

Texts: Kemp, *Ore Deposits in the United States and Canada.*
Spurr, *Geology Applied to Mining.*
Posepny, *Genesis of Ore Deposits.*

References:
Beck, *The Nature of Ore Deposits.*
Phillips, *A Treatise on Ore Deposits.*
Bulletins, monographs, folios, etc., of the United States Geological Survey.
Economic Geology and other mining magazines.

7. Economic Geology, B.

This course embraces the study of deposits of non-metallic minerals of economic importance, the geologic aspect being emphasized. The substances considered are coals, oils, gas, clays, cement rock, limestone, salt, gypsum, sulphur, fertilizers, abrasives, gems and minor minerals.

Prerequisites: Courses 2 and 3 of this department.

Time: Class-room two hours a week, second semester.

References: Ries, *Economic Geology of the United States.*
Merrill, *Rock-forming Minerals.*
Crosby, *Chemical Geology.*
Mineral Industry of the United States.
U. S. G. S. Publications.

8. Lithology.

In the study of rocks, special emphasis is given to the texture and to the mineral composition as determined by a hand lens and knife, with the purpose of acquiring the ability to make a classification in the field. First, the igneous rocks are studied, then the sedimentary rocks and finally the metamorphic ones.

The study of Lithology should be taken up at the same time as Structural Geology as they can well be correlated.

Prerequisites: Courses 1, 2 and 3 of this department.

Time: Class-room, two hours a week, first semester.
Laboratory, three hours a week, first semester.

Texts: Kemp, *Hand-Book of Rocks.*
Diller, *Educational Series of Rock Specimens.*

References: Geikie, *Text Book of Geology.*
Chamberlin and Salisbury, *Geology.*

9. Structural and Dynamic Geology.

In this course, the major and minor structure of rocks are considered, hypotheses and theories being developed where possible, and the bearing on mining geology being constantly in mind. Among the subjects treated are: classification of igneous rock masses by their shape, mechanics of igneous intrusion, joints, folds, faults, stratification, results of moving shoreline on sediments, formation of limestone, dolomitization, regional metamorphism, contact metamophism.

Prerequisite: Course 3 of this department.

Time: Class-room, three hours a week, first semester.

Texts: Geikie, *Text Book of Geology.*
Chamberlin and Salisbury, *Geology.*
Van Hise, *Treatise on Metamorphism.*
Crosby, *Chemical Geology.*

10. Geological Surveying, A.

In this course, the students are divided into pairs, each pair working on an area of fifteen or twenty square miles. First, reconnaissance trips are made over the district and, later, detailed work is done and the contacts and relative ages of rocks determined. Each pair of students make a geologic map and report of their district, particular attention being given to problems of structure, ore deposits, etc. The Socorro sheet of the topographic maps issued by the United States Geological Survey is used as a base-map.

Prerequisites: Courses 2, 3 and 5 of this department.

Time: Class-room, one hour a week thruout the year.
Field, eight hours a week thruout the year.

11. Geological Surveying, B.

This is more advanced than the preceding course and deals with problems in structural and dynamic geology, petrography, ore deposits, stratigraphy and correlation.

Prerequisite: Course 10 of this department.
Time: Class-room, two hours a week thruout the year.
Field, eight hours a week thruout the year.

12. Petrography.

As introductory to this course, optical mineralogy is first studied, particular attention being given to the subject of polarization, optical constants and the effects produced by thin sections of various minerals beween Nicol prisms both in parallel and in converged light.

The principles thus studied and the differences observed are then used by the student to extend his acquaintance with the various types of rock in the form of mineral aggregates as well as in the form of individual crystals. The appearance which the igneous rocks present when viewed in thin sections under the microscope is thoroly considered. The lectures take up the simpler granites and, in order, the rest of the acidic series, then the members of the intermediate series, the basic series and finally the small group of the utra-basics. With the last mentioned series, the celestial rock-types are briefly treated.

Particular attention is paid to the alteration of minerals in rocks, as disclosed by the miscroscope, for the reason that the subject has such an important bearing upon rock metamorphism in general and the formation of ore-bodies in particular.

The subject of the separation of rock constituents by means of heavy solutions and the microchemical reactions are entered into with considerable detail.

Each student is required to identify a number of samples of rock by preparing thin sections from them and subjecting these sections to microscopical examination.

Prerequisites: Course 8 of this department and Course 2 of Department II.
Time: Class-room, two hours a week, second semester.
Laboratory, four hours a week, second semester.
Text: Rosenbusch-Iddings, *Microscopical Physiography of the Rock-Making Minerals.*

13. Topographical Mapping.

A course in topographical mapping in accordance with the methods followed by the governmental bureaus of all civilized nations. The methods of the United States Geological Survey in particular are fully considered and ample field practice afforded. The relations of geologic structure to topograpic expression are discussed, numerous practical illustrations explained and examined on the

ground. All factors entering into the preparation of an adequate topographic base for exact geologic mapping of rock-masses and the proper representation of geologic structures are viewed in their different aspects and the construction of a suitable topographic base-map is carried out in a practical way. The various methods are considered in detail and the advantages and shortcomings of each under different conditions are discussed and compared. Practice in primary triangulation and secondary triangulation and the filling in of the larger triangles by plane-table methods is made a feature. In putting in the topography, the contour method is chiefly adopted and particular attention given to the morphogenic expression of earth-sculpture.

A student may select one of several prescribed areas of 25 square miles each in which there is a great diversity of surface-relief and geologic formations and will be given every opportunity to perform all the work with proper supervision, as a part of a comprehensive scheme for mapping the region which the School has begun. For this work, credit is given both on the published map and in the accompanying printed reports.

Prerequisites: Course 1 of this department and Course 3 of Department V.

Time: Class-room, one hour a week, first semester.
Field anr laboratory, six hours a week, first semester.

14. Ore Deposits.

Theories of ore deposition are taken up in greater detail than in Course 6 and are subjected to more critical study and the role of igneous rocks in the formation of ore deposits is treated more elaborately than in the latter course. Conditions governing the formation of spaces, water circulation, precipitation and the filling of spaces, replacement, rock alteration and parageneses of minerals are taken up. The original literature is consulted wherever possible and much collateral reading is done.

Prerequisites: Courses 6, 8 and 9 of this department, and Courses 1, 2 and 3 of Department VII.

Time: Class-room, two hours a week, first semester.

Text: Posepny, *Genesis of Ore Deposits.*

15. Paleontology.

A brief view of the fossils is taken with special reference to the geological succession in Southwestern United States. Characteristic types of each of the geological periods are studied with care. The methods of determining geological horizons by means

of fossils are discussed and allusion made to geological correlations.

Prerequsites: Courses 1 and 4 of this department.

Time: Class-room, two hours a week, one year.
Field and laboratory, three hours a week, one year.

Text: Zittel-Eastman, *Paleontology.*

16. Special Problems.

It is expected that the student has already become more or less familiar with the various districts in the neighborhood of the School. He is encouraged to take up the exhaustive study of some limited area, in conjunction with, or under the guidance of his instructor, or he is given some area or theme that has already been well worked out and the results published, and he is required to repeat the investigation on his own account. There is a wide range of topics from which to select. Nearly all departments of geology offer problems that are both varied and highly instructive.

17. Research Work.

It is a recognized tenet of the institution that the greatest benefits are not secured to the student until his training has been such as to enable him to conduct independent investigation. During the period of preparation previous to the time when independent inquiry is taken with profit, many problems will have suggested themselves for solution. If, however, the student has been unable to make any selection of topic for himself, a suitable problem will be assigned to him.

The opportunities and facilities for research work in nearly all branches of geology are so numerous and the entire field is such a virgin one that it is doubtful whether any other region in the whole country is so inviting as that of New Mexico.

For the study of mountain structure, no region surpasses southwestern United States. The effects of vast erosion, the dry climate, the prodigious faulting and tilting of orthographic blocks, all contribute to expose the stratigraphy and structure on a scale not to be comprehended elsewhere on the continent.

Many of the broader philosophical questions which now hold the attention of geologists the world over find ample illustration in New Mexico. Mountain building, epeirogenic movements, isostatic adjustment, vulcanism, land-sculpture and extensive sedimentation far removed from the sea, find innumerable phases awaiting careful study.

Mineralogy, petrography, ore-genesis and paleontology also offer new fields for profitable research.

18. Thesis.

Those students electing the curriculum in Mining Geology are expected to defend creditably the conclusions drawn from some more or less extended investigation. The theme may be in the nature of an extension of work already begun in the previous years, a special phase suggested during the preliminary researches, or on some entirely new subject selected by the candidate for a degree or by his instructor. Besides being distinctly a contribution to knowledge, the thesis must show ample evidence of a wide acquaintance with the literature directly bearing upon the theme.

It is expected that the student during the last year of his course will devote at least one-third of his time to the preparation of his thesis. The subject of the thesis must be announced at least one year prior to the time when the student intends to come up for his degree, and be approved by the instructor under whose supervision the work is undertaken. If accepted, the thesis is required to be printed in standard form, or, if in part, to the extent of at least 20 pages, and 150 copies presented to the School.

VII. DEPARTMENT OF MINING ENGINEERING.

REINOLD V. SMITH, Professor.

The instruction in mining is given by means of lectures illustrated by photographs and detailed drawings. Recitations are held on assigned topics, and field examinations are made. The latter enter largely into the more practical part of the work. Mine administration and mining law receive complete treatment. The entire course is pre-eminently practical in character, and articulates closely with both the courses in mining engineering and mining geology.

As one of the chief purposes of the School is to prepare men to become designers of mining plants and supervisors of mining operations, the strictly business character of the profession is kept constantly before the student. Valuing property, properly reporting propositions submitted for investment, calculating in a careful manner all the factors in the economical operation of a plant and suggesting the best methods of developing a property, are considerations which receive careful treatment and are given prominence during the latter part of the curriculum.

Especially are the similarities and departures between the operations and requirements of metal-mining and coal-mining brought out. Placer and hydraulic mining and dredging, and the recent adaptation of the steam shovel and stripping methods to western metal mines are treated at considerable length in the course on Mining Methods.

Another important feature which is continually being more and more considered in mining operations is the geology of the mineral deposits, and this subject receives greater attention than uusual.

1. Mining Methods, A.

The following subjects are studied:

Mineral deposits, their classification from a mining standpoint and their irregularities as affecting the work of exploration and mining.

Examination of mineral properties; relation of topography to geological structure; tracing of probable outcrops.

Prospecting by ditches, pits and deep borings.

Development; choice of methods; location of openings.

Excavation of earth; tools; methods; supports.

Excavation of rock; explosives, kinds, nature, manufacture and use; methods of drilling and blasting, mammoth blasts, submarine blasting; quarrying.

Tunnelling: methods of driving and timbering; submarine tunnels; permanent linings; sizes, speeds of advance and costs.

Boring: methods and appliances for small depths and for deep boring; the diamond drill; survey of bore holes.

Shaft-sinking: methods and tools for both hard and soft material; sinking; lining; handling and hoisting of material; timbering, walling and tubbing.

Surface workings and hydraulic mining.

Prerequisites: Courses 3, 4 and 5 of Department I, Courses 1, 2, 5 and 6 of Department II and Courses 1 and 2 of Department III.

Time: Class-room, four hours a week, second semester.

Texts: Foster, *Ore and Stone Mining.*
Ishlseng, *Manual of Mining.*

2. Mining Methods, B.

The subjects studied are:

Surface-handling and transportation; arrangements for loading, unloading and storage of minerals; mineral railroads and common roads.

Water supply.

Drainage: sources, control and raising of mine waters; dams; drainage-levels.

Ventilation: requirements for pure air; vitiation and purification of mine-air; methods of ventilation; measurement and control of air-currents.

Illumination: candles; torches; lamps classified as oil, gasoline, magnesium, acetylene, electric and safety.

Accidents to men from fire-damp, dust explosions, mine-fires, falling material and inundations; prevention; rescue and relief.

Prerequisites: Same as for preceding course.

Time: Class-room, four hours a week, first semester.

Texts: Same as in Course 1.

3. Inspection of Mining Methods.

By inspection of mining methods followed in the various camps in the neighborhood of the School there is afforded great variety of illustration of the themes developed in the lectures.

The inspections are carried on partly as class-work in company with the instructor in charge, and partly as individual work. Full notes are required to be taken and these are subsequently reduced

in the office to proper form, accompanied by the necessary sketches and plans to make the whole procedure thoroly intelligible.

Prerequisites: Courses 1 and 2 of this department.

Time: Field, five hours a week, second semester.

4 Ore Dressing.

An advanced course, the elements having been taken in General Metallurgy. In it is comprised a detailed study of severing by means of breakers, rolls, stamps and fine grinding machines; the sizing and classification of pulps by mechanical, pneumatic, and hydraulic processes; the principles and importance of sizing and classifying; the separation and concentration by hydraulic and electrical methods and also by means of oil and acid flotation.

Prerequisites: Course 6 of Department I, and Courses 1, 5 and 8 of Department II.

Time: Class room, three hours a week, second semester.

Text: Richards, *Ore Dressing and Concentration*.

5. Ore Dressing Plant Design.

This course is for the students of Mining Engineering. The time is occupied in making detailed and original plans for a plant for ore treatment. The designs are based upon surveys made by the student upon sites especially selected for the particular problem. The working plans for the buildings, roads, bins, transportation systems, concentrators, etc., are drawn up complete in every respect, with bills of materials and specifications on selected portions of the plant.

Prerequisites: Courses 4, 7 and 8 of Department II; Courses 6 and 8 of Department VI, and Course 4 of this department.

Time: Laboratory, four hours a week, first semester.

6. Mine Plant.

The following machinery and appliances are studied and critically discussed.

Hoisting: engines, drums, wire rope, skips and cages; headframes; calculation of power required and methods of equalizing the load on the engine; devices for prevention of over-winding; shaft-sinking plant.

Drainage: buckets, tanks and head-pumps; Cornish and direct-acting underground pumps; operation of pumps by electricity, compressed air and hydraulic power.

Ventilation: natural ventilation, underground furnaces, positive blowers and centrifugal fans; efficiencies of fans.

Air-compressors: straight-line and duplex; simple and compound compression; heat of compression; conveyance of compressed air; efficiencies.

Machine drills: construction and operation.

Underground haulage: mine cars; arrangement of tracks; hand tramming; mule and rope haulage; gravity roads; steam, compressed air and electric locomotives; comparative efficiencies.

Prerequisites: Courses 1, 2 and 3 of this department.

Time: Class-room, three hours a week, one year.

7. Mine-Plant Design.

As in the designing of a metallurgical plant, the student takes up a given mine, makes all the proper surveys, plans the top-works, makes full work-drawings of all buildings, trams, ore-bins and similar constructions, and draws up detailed specifications, bills of materials and full estimates of cost on the portions selected.

If an operating mine happens to be selected for this, the entire work is examined, improvements incorporated, and suggestions made as to possible savings. This work, when further elaborated, may be accepted as a thesis.

Time: Laboratory, six hours a week, one year.

8 Mine Administration and Accounts.

In all the mining courses, particular stress is laid on the business aspects of mining operations. The value of keeping tabulated record of different grades of work and its cost from day to day is urged as a means of constantly reducing the fixed charges and of doing away with much of the extraordinary expenditures without reducing the efficiency of the work. The devising of methods of increasing the output with limited working forces is emphasized.

Not only are the subjects of labor in all its various phases, the details of supplies, and the sale of ore prepared for market taken up, but mine accounts, statements of cost and monthly reports are discussed.

Time: Class-room, two hours a week, first semester.

9. Mining Law.

A short course of lectures on mining law (particularly in relation to the manner of locating placer, lode and tunnel claims), on water rights, law of the apex and similar questions.

Time: Class-room, one hour a week for eight weeks, first semester.

10. Examination of Mines.

The main object sought in this course is to train the student sufficiently in expert mine examination work to enable him to report intelligently upon a mining proposition as to the advisability of purchase or of operation.

Practice is afforded in making regular reports, complete in every respect, on different kinds of mining properties. Each student is assigned a different mine or property to examine. In case the mine has been reported upon in previous years, detailed comparison of the results is afterwards made.

Among the more important topics usually considered are the topography of the district as an index to its accessibility, outside constructions, the character of the geological formations, the geological structure (particularly as affecting the ore bodies), the character and disposition of the ores, the amount of ore developed, the probable extent of the unexplored part of the deposit, the best method of extracting the ore, of concentrating it, of preparing it for shipment or treating it immediately for the metal, the water facilities and the facilities for transportation to market. Full computations are required, including estimates of the cost of each process, of the necessary plant, and of each of the various parts.

Prerequisites: Courses 1 and 3 of this department, Courses 2, 4, 6*, 8* and 9 accompanying or preceding; Courses 1, 6 and 7 of Department VI, Course 12 accompanying or preceding.

Time: Field, ten hours a week, first semester.

*Courses 6 and 8 are not prerequisites to Mine Examination in the Mining Geology curriculum.

VIII. DEPARTMENT OF METALLURGICAL ENGINEERING.

REINOLD V. SMITH, Professor.

The Metallurgical Department aims to turn out its graduates equipped with the knowledge necessary to the successful management of metallurgical plants, and to take full charge of metallurgical operations. The graduate from this department has acquired a good working knowledge of assaying, chemistry, mill-work and smelting processes.

The courses have been chosen with special reference to giving to the student in metallurgical engineering a general knowledge of modern metallurgy as a whole, and special knowledge of the metallurgy of each of the more impotrant metals. This special knowledge is attained by lectures, readings, discussions, laboratory work and inspection of metallurgical plants.

1. Fire Assaying.

The instruction in assaying is given by means of lectures and laboratory experimentation, the practice in the laboratory illustrating the lecture-courses. The laboratory is well equipped with several different types of assay-furnaces for crucible work, scorification and cupellation, and with everything that goes to make up a well furnished assay-office.

This course comprises fusion methods for gold, silver and lead; the crucible-assay of oxidized ores for gold and silver in the muffle and in the pot-furnace; crucible assay of sulphide ores for gold and silver by the iron, roasting, and preliminary fusion methods; also the crucible assay of lead ores. The scorification-assay of mattes and speisses, with preliminary wet treatment; assay of litharge and lead. In the assay of base-bullion, silver-bullion and gold-bullion, the methods in use in the United States mints are followed. Sampling and the preparation of the sample for assay; making cupels.

Numerous samples are provided, all of which have been previously accurately assayed at the College, at the smelter whence they came, or at the mint. The student works upon these until he attains a high degree of proficiency. No student is allowed to pass this subject until he has become an experienced assayer.

Prerequisites: Courses 1, 2, 3 and 4 of Department III, and Course 2 (c) of Department VI.

Time: Class-room, one hour a week, second semester.
Laboratory, eight hours a week, second semester.

Texts: Lodge, *Notes on Assaying*
Rickett and Miller, *Notes on Assaying.*

2 General Metallurgy.

A study of the physical and chemical properties of ores and metals as determinants in extraction-methods; furnaces, their classification and structure; fuels and thermal measurements; characteristic metallurgical processes; materials and products of metallurgical processes; alloys; thermal treatment of metals preparatory to their use.

The most recent practical processes will be also presented and local metallurgical processes will be considered.

The course is to be supplemented by visits to neighboring plants and, at the end of the school-year, by vacation trips of metallurgical inspection.

Prerequisites: Courses 1 and 2 of Department III; Course 1 of Department II and Course 2 of Department VI must precede or accompany.

Time: Three hours a week, first semester.

Texts: Roberts-Austen, *Introduction to the Study of Metallurgy.*
International Library of Technology, *Gold, Silver, Lead and Zinc.*

3. Metallurgy of Lead.

An advanced course in lead-metallurgy; occurrence of lead; the lead reverberatory furnace; Corinthian, Silesian and English methods of treating lead ores in the reverberatory furnace; Scotch, American and Moffet types of ore hearth; smelting lead ores in the ore-hearth; roasting-furnaces for lead ores; roasting galena as a preliminary to blast-furnace treatment; the lead blast-furnace; calculation of blast-furnace charges; details of running a lead blast-furnace; desilverization of base bullion.

Prerequisite: Course 2 of this department.

Time: Class-room; two hours a week, second semester.

Text: Hoffman, *Metallurgy of Lead.*

4. Metallurgy of Copper.

Occurrence of copper; roasting copper ores in heaps, stalls and roasting furnaces; blast-furnace smelting; pyritic smelting; reverberatory smelting; bessemerizing copper mattes; electrolytic refining of copper; selection of process and management of plant.

Prerequisite: Course 2 of this department.
Time: Class-room, two hours a week, first semester.
Text: Peters, *Modern Copper Smelting.*

5. Metallurgy of Gold and Silver.

Occurrence of gold and silver; placer mining; the patio process; crushing and amalgamating machinery; pan amalgamation; chlorination by the vat and barrel processes; cyaniding by the MacArthur-Forest and Siemens-Halske processes; modern methods of cyanid treatment of slimes by pressure and vacuum filters; lixiviation of silver ores; pyritic smelting; refining and parting of gold bullion.

Prerequisite: Course 2 of this department.
Time: Class-room, two hours a week, second semester.
Texts: Rose, *Gold.*
Collins, *Metallurgy of Silver.*

6. Metallurgy of Iron.

Modern methods of the production of pig iron, wrought iron and steel; the iron blast-furnaces; white cast-iron; gray cast-iron and spiegel-iron; puddling; wrought-iron; the Bessemer and Siemens-Martin processes; steel.

Prerequisite: Course 2 of this department.
Time: Class-room, two hours a week, first semester.
Text: Howe, *Metallurgy of Steel.*

7. Metallurgical Inspection.

Visits of inspection to mills and reduction-works. While these visits are required during the third year only, at which time the student is capable of understanding all he sees and thus deriving the maximum amount of benefit from it, students not so far advanced are advised to take these trips whenever it does not seriously conflict with other studies.

A visit may be extended by special permission and the mill or reduction-works used to furnish the material for a thesis.

Prerequisite: Course 2 of this department.

8. Metallurgical Design.

Some time during the latter part of the general course in metallurgical engineering, the student devotes a part of his time to detailed and original plans for a plant for ore treatment. From year to year, the conditions vary so that no two persons have the same work. The designs are based upon the surveys made by the student upon sites especially selected for peculiar conditions presented. The working plans for the buildings, concentrators, furnaces, etc., are drawn up complete in every respect, the full bill

of materials made out and the cost of the several parts and of the whole carefully estimated according to the trade conditions and labor factors existing at the time. In fine, the entire work and all computations are carried out according to the best engineering practice, and with the same care that actual construction operations require.

Prerequisites: Courses 4, 7 and 8 of Department II, Course 6 of Department VI, and Course 2 of this department.

9. Metallurgical Laboratory.

This course includes experiments in the following; thermal measurements; thermal treatment of iron; the melting-points of some metals and alloys; properties of refractory materials; properties and reactions of gold, silver and copper; bullion and cyanide-product refining, manipulation and evaluation; ore testing as to the applicability of cyanide, amalgamation and concentration processes.

Prerequisite: Course 1 of Department VIII.

Time: Class-room, one hour a week, first semester.
Laboratory, eight hours a week, first semester.

Texts: Lodge, *Notes on Assaying.*
Howe, *Metallurgical Laboratory Notes.*

10. Thesis.

Each student, before receiving the degree of Metallurgical Engineer, is required to prepare and to present to the Faculty an important scientific treatise upon a metallurgical subject. This treatise must be based upon work carried out by the writer while a student at the College. It must contain a complete record of all work performed by the writer upon the subject treated, the conclusions drawn from the work, and a statement of the lines along which, in the writer's opinion, it would be advisable to pursue the investigation further.

BUILDINGS AND GROUNDS.

The Campus.

The School of Mines campus is situated on the northwest edge of Sororro. It contains 20 acres of nearly level ground within the irrigable belt. Groves of trees have been planted; and trees line the walks and drives.

Main Building.

The main building consists of three stories and a high basement. It is T-shaped, 135 feet long by 100 feet, the central rear wing being 54x32 feet. It is constructed in a very substantial manner of a beautiful gray granite, in broken ashler, trimmed with Arizona red sandstone.

The building is handsomely finished thruout in oiled hard woods. It is well ventilated and has all modern conveniences, being piped for water and gas and heated by a good hot-water system. Electric lights for illumination and for experimental purposes will be put in before the opening of the coming school year.

As now arranged, the main floor of this building contains the president's office, the general library, the chemical laboratory, instructor's office, assay-laboratory, balance-rooms and lecture-room. The basement contains the mineralogical museum, lecture-room, chemical supply-room, boiler-room, engine-room, lavatories and general storage-rooms. A lecture-room occupies most of the second story. The third story includes a lecture-room, supply-room, photographic dark-room and storage closets.

Engineering Hall.

The south wing of this building has already been erected. It is built of Socorro cream brick with gray trachyte trimmings.

As planned for completion, the building is to be X-shaped, the central pavilion two stories and the four wings one story. With its spacious rooms, it will be peculiarly adapted to engineering instruction.

When the building is completed, the entire north wing will be devoted to draughting purposes, the light coming from above. At present, the main draughting-room is in the south wing which also is a lecture room. Off this are the instructor's office, and a blue-print room. A photographic room is fitted up in the main building.

Dormitory.

The New Mexico Legislature, during its last session, appropriated $15,000 for the erection of a dormitory for the students.

The plans are already under way and it is expected that the building will be ready for occupancy by the opening of school. A dining hall is to constitute a part of the building and students will be able to get board and room at a low cost.

EQUIPMENT.

Chemical Laboratory.

The chemical laboratory of the New Mexico School of Mines is very complete in its equipment, every thing being provided for the needs of the students in their various courses. The laboratory is equipped with desks, one of which is assigned to each student. Each desk is six by two and one-half feet and thirty-eight inches high and has a cupboard on one side and a tier of five drawers on the other, all under Yale locks. There are water and gas connections, sink, and shelves for reagents with each desk. Every student in chemistry is supplied with a complete set of reagents and all apparatus for the work to be undertaken. For general use, are provided evaporation-hoods, special tables and a balance-room containing quantitative balances of Becker's construction.

The chemical lecture-room is provided with standard lecture-room chairs, especially adapted to the convenience of students in taking notes. The lecture-table, extending across one end of the room, is fitted with water and gas-connections and large sink,

Assay Laboratory.

The assay laboratory occupies the main floor and basement of the west wing of the main building. The furnaces are all new and include muffle gasoline blow-pipe furnaces of different types, and large muffle-coke furnaces. This department is conveniently arranged with shelving, drawers and boxing for fluxes and other assaying materials and supplies.

A weighing-room, containing a number of Becker's balances, is conveniently located between the furnace-room and the lecture-room. In the grinding-room, which is in the basement, is an 8-horse power gasoline engine of Weber type, which runs the Dodge ore-crusher, a Bolthoff sample-grinder, and will supply power thru a line of shafting to other machines. There are also a Bosworth laboratory crusher, bucking-board, mullers and other necessary apparatus.

Physical Laboratory.

The physical laboratory, on the third floor of the main building, contains the usual apparatus for illustrating the facts and laws of physics. In addition, there has just been added, at a considerable

expense, all the apparatus necessary to perform the quantitative experiments outlined in Course 1 of Department II.

Petrographical Laboratory.

For the miscroscopic study of rocks, both in elementary and advanced or graduate work, the School is well supplied with microscopes and other necessary apparatus. There has recently been added to the equipment a new style large microscope, manufactured especially for this institution by Reichert, of Vienna. It is constructed especially for obtaining fine results in microphotographic work. The stand includes a Continental Model substage with rack and pinion, an Abbe substage condenser, with iris diaphragm, plane and concave universal mirror, triple nose-piece, and a full set of objectives and eye-pieces. Among the accessories are a micrometer eye-piece, compensating eye-piece, polarizing apparatus, stage micrometer, drawing apparatus, quartz-wedge, quarter-undulating mica plate, and other necessary pieces.

A rock-slicing machine with power attachments enables the student to prepare thin sections of the rocks which he is studying.

Among the series of thin-slices of rocks, are a collection of types of the massive crystallines of Europe, prepared by Krantz of Bonn, and completely illustrating Zirkel, sets of Maryland massives, and other American rocks and minerals. The Sturtz collection of European rocks illustrating Rosenbush and large miscellaneous collections are expected to be soon available for study.

Engineering Department.

For land, railroad and mine-surveying the department has full sets of instruments, including transits, levels, poles, leveling-rods, chains, pins, steel-tapes, hand-levels, compasses and clinometers.

The department has lately added to its equipment a fine large engineer's transit and all accessories, manufactured expressly for this institution, after improved designs by the Gurleys of Troy. There is included an extension tripod, auxiliary telescope, reflector, gradienter attachment, diagonal prism and solar apparatus.

Draughting Rooms.

A spacious, well-lighted draughting-room is provided in the engineering building. Opening off from it are the instructor's office, supply-room, blue-print room with large printing frame on steel track; developing-vat and drying-rack.

A drawing table is furnished each student. There are private spaces for his materials and instruments. Provision is also made for models and illustrative materials.

The photographic room is located in the main building.

Mineralogical Museum.

The School owns a very fine collection of minerals of all kinds. These, properly labeled and arranged in glass cases, are housed in the north wing of the main building.

The major part of the New Mexico mineral exhibit at the Louisiana Purchase Exposition at St. Louis consisted of the collections prepared by the School of Mines. The display occupied a prominent place near the center of the Palace of Mines and Metallurgy. As the only exhibit of the kind made by a mining school, it attracted wide attention.

The display was planned to center around a large colored relief-model of New Mexico on a scale of half an inch to the mile—or nearly 20 feet square. On this model was shown all the mineral resources. It was accompanied by a large colored section of the geological formations.

Arranged in a score or more of large glass cases, were the leading mineral products of New Mexico, selected with special care as to value and beauty. Included, were a number of cases of remarkably rare and showy zinc and copper minerals and ores. A special series consisted of zinc carbonate minerals which, for variety, delicacy of coloration and beauty have never been surpassed. Two immense pyramids of showy crystalline ores were embraced in the display.

Four large special collections were of particular interest. These consisted of (1) the largest variety of zinc and copper minerals and ores from a single locality; (2) a collection of rare zinc and copper ores; (3) a unique collection of showy crystals of zinc and copper minerals; and (4) a complete smelting proposition from a single mine.

For these displays and several others, gold and silver medals were awarded.

All the collections have been returned to Socorro and now form a prominent feature in the museum of the School of Mines.

LIBRARIES.

The libraries of the New Mexico School of Mines consist of a general library and department libraries.

In the main library are the works of reference, the encyclopedias, dictionaries, journals, magazines, proceedings of the learned societies, periodical issues of other colleges, reports of federal, state

EXHIBIT OF RARE ORES AND MINERALS AT ST. LOUIS.

and foreign surveys, official maps, plats and atlases, and volumes on history, travel and philosophy.

The following periodicals are received by the School:

Engineering and Mining Journal.

Mining and Scientific Press.

Engineering Record.

Power.

Engineering News.

Mining Science.

Mines and Mining.

Mines and Minerals.

Engineering Magazine.

American Chemical Journal.

Review of Reviews.

Economic Geology.

School of Mines Quarterly.

New Mexico Journal of Education.

All the U. S. G. S. Publication.

Libraries are located in the several departments of the school. These are essentially working libraries. They consist of carefully chosen treatises, text-books, monographs, special contributions, and authors' separates, pertaining to the respective divisions.

Powell Library. The School has come into possession of the private library of the late Major John W. Powell, of Washington, D. C., who for many years was director of the United States Geological Survey. The collection embraces several thousand titles. The volumes are chiefly works on mining, geology and philosophy, many of which are rare, and all are of great practical value. Especially well represented is the literature relating to the Rocky Mountain region and the great Southwest. It was in these fields that Major Powell did most of his work, which has had such an important influence on the development of the mining industry. It therefore seems particularly fitting that the library of this famous man, who had been so long identified with this western country, should find a permanent home in New Mexico.

THE TORRANCE MINE.

The School of Mines has become the owner of the Torrance Gold and Silver Mine at the base of the Socorro Mountain, only about two miles from the School campus. This mine affords excellent opportunities for the practice of mine-surveying and for a study of all the various features of practical mining. Here are to be studied a double-compartment incline shaft, a fine example of mine-timbering, various levels, cross-cuts, winzes, shafts, stopes, ore-bodies with associated geological structures and many other features of interest to the student of mining engineering.

INSPECTION VISITS.

Students in the mining and metallurgical courses are expected to make a two weeks' tour of inspection of the mines, concentrators and smelters lying within easy reach of Socorro under the direction of the professor of mining and metallurgy. This tour may be made either during the Christmas vacation or at the close of the school year. Special stress is laid upon the proper keeping of notes. These are fully written up each day and are made use of later as a basis of other work in connection with the regular courses. If carefully kept, they prove valuable references in later years.

At the close of the school year 1906-7, inspection visits were made to the mines, concentrators and reduction works at El Paso, Douglas, Bisbee, Tombstone, and Cananea.

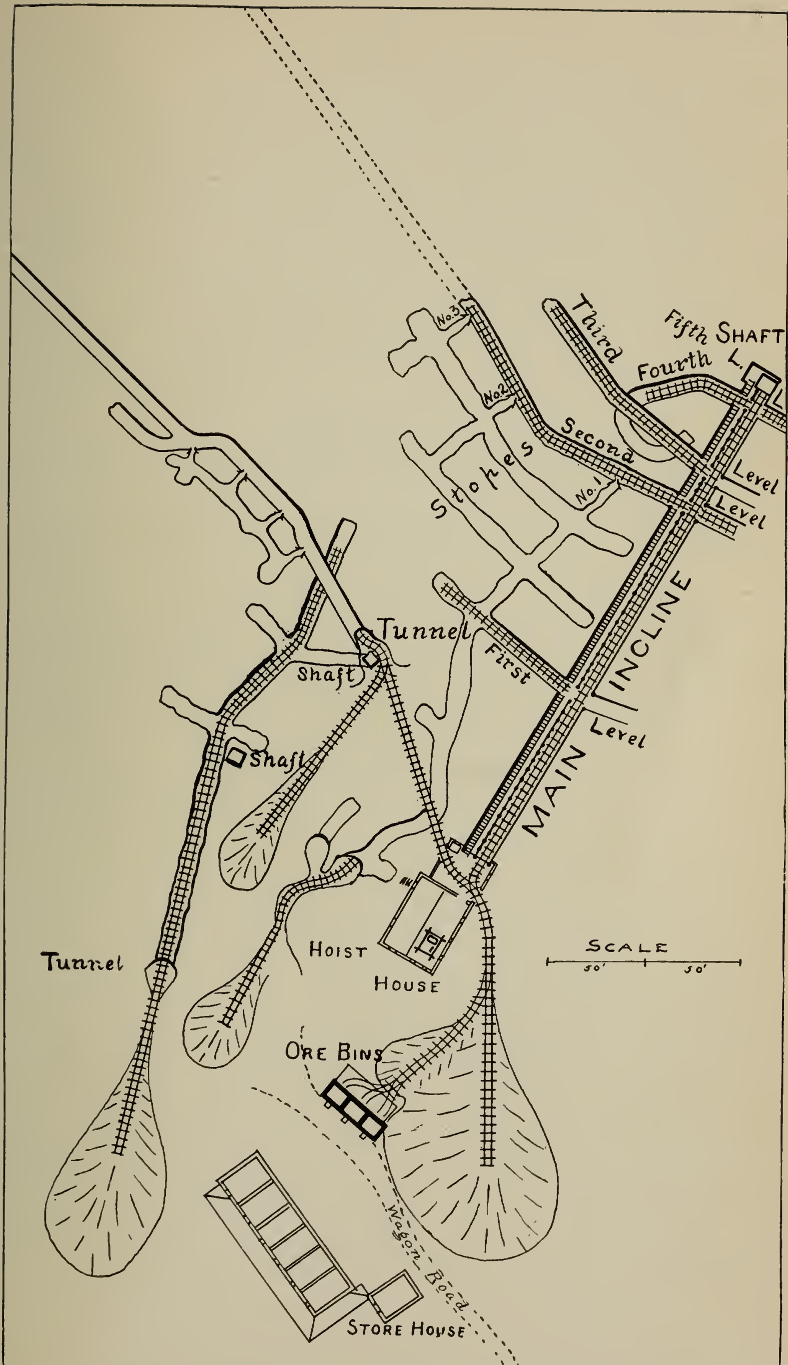
EXPENSES.

Matriculation Fee.

A matriculation fee of five dollars is required of each student before beginning work in the School for the first time and, of course, is paid only once.

Tuition Fee.

The fee for tuition is twenty-five dollars a semester except to citizens of New Mexico, the tuition fee for the latter being ten dollars a semester. This fee is payable at registration and its payment, after matriculation, admits the student to all class-room instruction.



PLAN OF THE TORRANCE MINE.

Laboratory Fees.

The laboratory fees are intended to cover the cost of gas, water and materials for which the student does not pay directly and to compensate for the depreciation, due to use, in the value of the apparatus. These fees are payable at the time of registration and are as follows: General Chemistry, Qualitative Analysis, Quantitative Analysis, Water and Fuel Analysis, Wet Assaying, each $5.00; Fire Assaying, $10.00; Mineralogy (Blowpipe Analysis), $3.00.

A deposit of $3.00 is required from each student who registers for any one of the foregoing courses. This deposit will be returned to the student after deducting any amount which may be due for the breakage of apparatus.

Graduation Fee.

The graduation fee, payable before delivery of diploma, is as follows:

Mining, Metallurgical, or Civil Engineer..............$10.00
Bachelor of Science.................................. 5.00

Board and Rooms.

Rooms may be obtained at a cost varying from $6.00 to $8.00 a month; board, at the hotels and best boarding-houses, for $5.00 a week. The cost of living will be materially reduced for the students as soon as the dormitory, with its dining-hall, is erected.

BOOKS.

Books are furnished to the students at cost.

SCHOLARSHIPS AND PRIZES.

Scholarships.

Thru the generosity of the members of the Board of Trustees, of the 37th General Assembly of New Mexico and of the Allis-Chalmers Company, the New Mexico School of Mines has been able to establish a system of scholarships. These scholarships are awarded annually as honors, the main object being to encourage earnest effort on the part of those who wish to prosecute studies related to mining in this institution.

School of Mines State-Scholarships. To one student from each state of the Union, is open a scholarship yielding free tuition. Each scholarship may be held for one year and is assigned to that applicant who shows the greatest proficiency in subjects already pursued by him. Application must be made in writing to the President and, in the case of those who have not been students in the School, must be accompanied by a certified statement of subjects pursued and the grades received therein, unless the applicant prefers to pass an examination in the subjects for which he seeks credit.

School of Mines County-Scholarships. Scholarships are open to two students from each county in New Mexico. These scholarships yield free tuition and are subject to the same conditions as the State-Scholarships.

New Mexico Scholarships. The 37th General Assembly of New Mexico gave to each representative, to each councilman and to each board of county commissioners the privilege of appointing a student to a scholarship in any one of the educational institutions of the Territory and provided an appropriation of $200.00 for each appointee.

Allis-Chalmers Scholarship. To one members of each year's graduating class, there is offered by the Allis-Chalmers Company, manufacturers of mining and heavy machinery, with large works at Chicago, Milwaukee and Scranton, an opporunity for four months' study and employment in any of its plants, and an emolument of $150.00.

This scholarship is awarded by the Board of Trustees on the recommendation of the Faculty from those graduates of the year filing application before the 10th of June. The opportunity is an exceptional one to observe and study the building of all kinds of modern mining and metallurgical constructions.

Prizes.

The Brown Medal. Hon. C. T. Brown, of Socorro, offers annually a gold medal to the student who, while doing a full year's work, has shown the greatest proficiency in the courses in Wet Assaying and Fire Assaying. The medal is awarded each year at commencement. Only those students are eligible as contestants for the medal who, at commencement, are found to have completed the courses named and, of course, the prerequisites to these courses.

SUMMER WORK.

The proximity of the School to mineral properties, mines and smelters makes it easy for the student to secure employment during the summer (and during the Christmas vacation, if desired) and, at the same time, to acquire much practical experience in the line of his profession. That this advantage has been appreciated is shown by the large proportion of students who yearly make use of this opportunity. During the past years, land-surveying, mine-surveying, geological surveying, assaying and mining have been attractive fields of work for the students during the vacations.

DEGREES.

The degrees of Bachelor of Science, Mining Engineer and Civil Engineer are conferred by the Board of Trustees upon recommendation of the Faculty.

The candidate for a degree must announce his candidacy at the beginning of the school year at whose termination he expects to receive the degree. This announcement must be in writing and must specify both the curriculum and the degree sought.

The degree of Bachelor of Science is conferred upon those who, as students of this institution, have completed the prescribed collegiate courses of the first three years in any one of the several curricula. This degree is also conferred upon those who, as students of this institution, have completed the courses which represent one full year's work in any one of the several curricula and have given satisfactory evidence of having previously completed the other courses of that curriculum.

The degree of Mining Engineer is conferred upon each one who, as a student of this institution, has completed the prescribed courses of the four-year curriculum in Mining Engineering, Metallur-

gical Engineering or Mining Geology, has presented an original and scholarly dissertation in the line of his work and has had this dissertation accepted by the Faculty. The degree is also conferred upon each one who, as a student of this institution, has completed the courses which represent one full year's work in one of the four-year curricula just named, has given satisfactory evidence of having previously completed the other courses of that curriculum and has complied with the specified conditions concerning a dissertation.

The degree of Civil Engineer is offered upon terms similar to those required in the case of the mining engineer, except that the candidate substitutes, in some of his later work, courses which relate more directly to the profession he expects subsequently to follow.

Work done at other colleges by candidates for a degree may be accepted so far as it corresponds to the work done here, but, in each case, the Faculty reserves the right to decide whether the previous work has been satisfactory.

It is expected that the thesis in each case shall be prepared with sufficient care and exhibit sufficient intrinsic evidences of independent investigation to warrant its publication, in whole or in part.

COMMERCIAL ANALYSES.

The wide demand which exists in the great mining district of the Southwest for disinterested and scientific tests and practical investigations has lead to the establishment, by the New Mexico School of Mines, of a bureau for conducting commercial work relating to mining and metallurgy.

The performance of such work is made possible, and accurate results assured, by reason of the exceptional facilities of the laboratories of the school and the extensive practical experience of the instructors. The rapidly increasing amount of this work intrusted to the school is sufficient evidence in itself that the plan has been long needed to further the development of the mineral resources of the region.

A special act of the Legislature makes provision for carrying on commercial testing. The section from the law governing the School of Mines, Chapter 138, Section 38, Acts of 1889, reads: "The Board of Trustees shall require such compensation for all assays, analyses, mill-tests or other services performed by said institution as it may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines."

A special circular is issued, giving the schedule of charges, other necessary information and methods of preparing and shipping samples. Copies are mailed on application. By special resolution, it is required that all charges shall be paid in advance.

Commercial Assaying. The assaying for gold, silver, copper, lead, zinc and the common metals, is carried on in all its various phases. All work is run in duplicate and, in case of any nonconcordant results, such assay is repeated. Particular attention is paid to umpire work.

Determinations of silica, iron, alumina, magnesia and manganese and of the rarer metals such as uranium, vanadium, nickel and cobalt are made according to the best methods.

Water Analysis. The chemical analysis of waters for city-water supplies, boilers and domestic use, and of mineral and mine-waters has, of late, assumed great importance. The chemical laboratory of the School is fully equipped for this work and, in the case of bad waters, remedies and methods to be used to improve the waters for specific purposes are suggested. A large number of analyses of waters from the Southwest have already been made, and very interesting results obtained.

Fuel Analysis. Another branch of work which has been constantly receiving more attention has been an inquiry into the fuel

values of the coals of the region. Complete analyses and heat tests, have been made of some of the principal deposits. With the work already done, the results of new analyses are made of special value on account of the comparative figures that can be supplied.

DIRECTORY OF GRADUATES AND FORMER STUDENTS.†

ARTHUR H. ABERNATHY. Cananea, Mexico.

Student 1898-1901. From Pinos, Zacatecas, Mexico. Assayer, Cananea Smelting Works, 1901.

C. E. BARCLAY. Maria, Texas.

(A. B. University of Virginia.)
Student, 1896-97. From Bowling Green, Kentucky.

JAMES F. BERRY. Fundicion, Sonora, Mexico.

Student 1904-5. From Socorro, N. M. Assayer with American Smelting and Refining Co., at Aguas Calientes, 1905; Assayer, City of Mexico, 1906-7; Chemist, Cia. Metalurgica y Refinadora del Pacifico, Fundicion, Sonora, Mexico, 1907-8.

LOUIS AUGUST BERTRAND. Upland, Nebraska.

Student, 1905-7. From Conway, Iowa. Student Ecole Professionella de l'East, Nancy, Lorraine, 1890-95; Instructor in Mathematics and French, New Mexico School of Mines, 1895-6; Chemist, El Paso Smelting Works, El Paso, Texas; Assayer and Surveyor, Consolidated Kansas City Smelting and Refining Co., Chihuahua, Mexico; Superintendent, Carmen Mines, Coahuila, Mexico; Superintendent, Compania Mineros de Penales, Mapimi, Durango, Mexico, 1901.

CHAUNCEY E. BUTLER.* Dedrich, California.

Student, 1893-6. From Kelly, New Mexico. Assayer, Cibolo Creek Mill and Mining Co., San Francisco, California, 1896; Assayer and Furnace Superintendent, El Compania Minera Lustre, Magistral, Estado de Durango, Mexico, 1897-98; Chemist and Assayer, United Verde Copper Co., Jerome, Arizona, 1898-1903; Superintendent, Trinity County Gold Mining Co., and Jenny Lind and Maple Mining Co., Dedrich, California, 1903.

R. HARLAND CASE. Colorado Springs, Colorado.

Student, 1902-5. From Cerrillos, N. M. Chemist, Compania Metalurgica de Torreon, Torreon, Mexico, 1905-6; Assistant Superintendent, Bonanza Mine, Zacatecas, Mexico, 1906; Assistant-Manager, Stephanson-Bennett Mining and Milling Co., Organ, New Mexico, 1906-7; Consulting Engineer, Western Mining, Milling and Leasing Co., Colorado Springs, Colorado, 1907-8.

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† Information concerning former students not here listed or concerning changes of address of those already listed will be gladly received.

* Deceased.

EDWARD C. CHAMNEY. Minnehaha, Arizona.

Student, 1899-1900. From Shipley, Ontario, Canada. Assistant in General Science, New Mexico School of Mines, 1900-01; Assayer, Oro Mining Co., Minnehaha, Arizona, 1901.

VIVIAN V. CLARK. Reiter, Washington.

Student, 1896-8. From Kelly, New Mexico. Assayer, Bland Milling Co., Bland, New Mexico, 1898-9; Superintendent, Navajo Gold Mining Co., Bland, New Mexico, 1900; Manager, Higueras Gold Mining Co., Sinaloa, Mexico, 1901; Mine Operator, Albuquerque, New Mexico, 1902; at present, Manager, Bunker Hill Mining and Smelting Co., Reiter, Washington.

DAVID JOSHUE CLOYD. Torreon, Coah., Mexico.

Student, 1899-1900. From Decatur, Illinois. Chemist and Assayer, Wardman's Assay Office, Aguas Calientes, Mexico, 1900-1906; Assistant Superintendent, Cia. Min. del Tiro General, Charcas, S. L. P. and Assistant Superintendent, Cia. del Ferrocarril Central de Potosi, Charcas, S. L. P., 1906-8; Assayer and Chemist, Dailey, Wisner & Co., Torreon, Coah., Mexico, 1908.

SAMUEL COCKERILL. Milwaukee, Wisconsin.

(B. S. New Mexico School of Mines, 1906.)

Student 1904-6. From North Fork, Virginia. Post Graduate Engineering student, Allis-Chalmers Co., 1906-1908; at present, Patent Draughtsman, Patent Department, Allis Chalmers Co.

THEODORE STEWARD DELAY. Creston, Iowa.

(B. S. and M. E., Missouri School of Mines.)

Graduate Student, 1893-5. From Creston, Iowa. Assistant Professor of Chemistry, New Mexico School of Mines, 1894; Assayer, Tassel Mining and Milling Co., Alma, Colorado, 1895; Assistant Superintendent, I. X. L. Milling and Refining Co., Breckenridge, Colorado; Manager, Hoosier-Yukon Mining and Milling Co., Forty-Mile District, Alaska; Metallurgist, Creston-Colorado Mining Co., Creston, Iowa, 1900.

LEON DOMINIAN. Zacatecas, Mexico.

(B. A. Roberts College, Constantinople, 1898; C. I. M. Mining School University of Liege, 1900.)

Graduate Student, 1903-4. From Constantinople, Turkey. Assistant, U. S. Geological Survey, 1903; Instructor in Mathematics, New Mexico School of Mines, 1903-4; Engineer to Victor Fuel and Iron Co., Denver, Colo., 1904-6; Superintendent, Bonanza Mine, Zacatecas, Mexico, 1906-7; at present, on extended tour thru Europe, Asia and Africa.

ROBERT CASIANO EATON. Leon, Guanajuato, Mexico.

Student, 1893-4. From Socorro, New Mexico. Sampling Mill Foreman, Compania Metalurgico Mexicana, San Luis Potosi, Mexico, 1894-98; Superintendent, Muriedas Smelting Works, Xichu, Guanajuato,

Mexico, 1898; Superintendent, Pozo del Carmen Railroad, Compania Metalurgico Mexicana, San Luis Potosi, Mexico, 1899-1902; Manager, Nuevo Cinco Senores Mining and Milling Co., Comanja, Jalisco, Mexico, 1902-4; Independent Assayer and Ore Buyer in Leon, Gto., Mexico, since 1904.

ALEXANDER WALTER EDELEN. Bonanza, Zacatecas, Mexico.

Student, 1905-6. From Baltimore, Md. Assistant Superintendent, Elkton Consolidated Mining and Milling Co., Elkton, Colo., 1906; Superintendent, Minas Bonanzas y Anexas, Zacatecas, Mexico, 1907.

THADDEUS BELL EVERHEART. Guanajuato, Mexico.

Student, 1905-7. From Bells, Texas. At present, Assayer and Surveyor, Pereguina Mining and Milling Co., Guanajuato, Mexico.

HARRY THORWALD GOODJOHN. Monterey, Mexico.

Student, 1902-3. From Pittsburg, Texas. Assayer, Cia Metalurgica del Torreon, State of Coahuila, Mexico, 1903-1906; Chief Chemist, Mapimi Smelter, 1906; Chemist and Metallurgist, Cia. Minera, Fundidora y Afinadora, Monterey, Mexico, 1907—

SAMUEL JAMES GORMLEY. West Jordan, Utah.

Student, 1895-6. From Mt. Vernon, Iowa. Assistant Professor of Engineering, New Mexico School of Mines, 1895-7; Assistant Assayer, Anaconda Copper Mining Co., Anaconda, Montana, 1897-1900; Chemist to same company, 1900-02; Superintendent of Sampling Works, Washoe Smelting Co., Anaconda, Montana, 1902-06; Smelter Superintendent, Bingham Copper and Gold Mining Co., West Jordan, Utah, 1906.

RUE N. HINES. Mocorito, Sinaloa, Mexico.

(B. S., New Mexico School of Mines, 1907.)

Student, 1904-7. From Socorro, New Mexico. Superintendent, West Coast Mining and Smelting Co., Mocorito, Sinaloa, Mexico, 1907—

ANTON HOGWALL. Nogal, New Mexico.

Student, 1898-99. From White Oaks, New Mexico. Assayer, Buckeye Mining Co., Water Canyon, New Mexico, 1900; Assayer, South Homestake Mining Co., and Helen Rae Ming. Co., White Oaks, New Mexico, 1901; Assayer, American Gold Mining Co., Nogal, New Mexico, 1902.

CARL JOHN HOMME. Gulf Creek, N. S. W., Australia.

(A. B. St. Olaf College.)

Graduate Student, 1899-1900. From Wittenburg, Wisconsin. Assayer and Chemist to Candelaria Mining Co., El Paso, Texas, 1900-01; Assistant Superintendent, Gulf Creek Mining Co., Gulf Creek, New South Wales, Australia, 1902.

WILLIAMS ELIAS HOMME. Gulf Creek, Australia.

(A. B. St., Olaf College.)

Graduate Student, 1902-03. From Wittenburg, Wisconsin. Assayer, Gulf Creek Mining Co., Gulf Creek, New South Wales, Australia, 1903.

HAYNES A. HOWELL. Esperanza, Puebla, Mexico.

Student, 1900-1905. From Socorro, N. M. Civil Engineer on railway from Acapulco, Mexico, 1906-7; Civil Engineer, Mexican Central R. R., 1907—

HARRY J. HUBBARD. Bonanza, Zacatecas, Mexico.

(B. S. New Mexico School of Mines, 1906.)

Student, 1905-6. From Bisbee, Arizona. Mine-foreman, Navidad Mine of Greene Gold-Silver Co., Concheno, Chihuahua, Mexico, 1906; Chemist, Navidad Mine of Greene Gold-Silver Co., 1906; Assistant Mill Superintendent, Sahuaycan Mining Co., Sahuaycan, Chihuahua, Mexico, 1906; Machine Drill Foreman, Sirena Mine, Guanajuato, Mexico, 1907; Shift-boss, Mexico Mines, El Oro, Mexico, 1907; Examiner of mines for T. H. Whelan & Associates, in southern states of Mexico, 1907; Tram-way Superintendent, Minas Bonanza y Anexas, Bonanza, Zac., Mexico, 1908.

JOHN AUGUST HUNTER. Aguas Calientes, Mexico.

(B. S., New Mexico School of Mines, 1903.)

Student, 1899-1903. From Socorro. Chemist, Consolidated Kansas City Smelting Co., El Paso, Texas, 1893-4; Chemist and Metallurgist, American Smelting and Refining Co., Aguas Calientes, Mexico, since 1904.

CHARLES THAYER LINCOLN. Brooklyn, New York.

(S. B. Massachusetts Institute of Technology, 1901.)

Graduate Student, 1902-3. From Boston, Massachusetts. Chemist to American Bell Telephone Co., Boston, Mass., 1901-2; Assistant in Analytical Chemistry, New Mexico School of Mines, 1902-3; Acting Professor, same, 1903-4; Instructor in Chemistry, Iowa State University, Iowa City, 1904-5; Chemist, Hartford Laboratory Co., Hartford, Ct., 1905-7; Chemist, Arbuckles Brothers Sugar Refinery, Brooklyn, N. Y., 1907.—

FRANCIS CHURCH LINCOLN. Butte, Montana.

(S. B., Massachusetts Institute of Technology; E. M., New Mexico School of Mines, 1902.)

Assayer to San Bernardo Mining and Milling Co., 1900; Chemist to Butterfly Terible Gold Mining Co., 1900-01; Professor of Chemistry and Metallurgy, New Mexico School of Mines, 1901-2; Professor of Metallurgy, 1902-04; Assistant Superintendent, Ruby Gold and Copper Co., Ortiz, State of Sonora, Mexico, 1904; General Manager, Arizona Gold and Copper Co., Patagonia, Arizona, 1904; Professor of Geology, Montana School of Mines, Butte, Mont., 1907.

HARRY C. MAGOON. Chicago, Illinois.

Student, 1899-1900. From Chicago, Illinois. Engineer with Illinois Steel Company, 1900.

CONRAD M. MEYER. New York, N. Y.

(A. B., New York University, M. D., Bellevue Hospital.)

Graduate Student, 1900-01. From New York City; 136 5th Avenue, New York City, 1901.

TARVER MONTGOMERY. Santa Ana, California.

Student, 1899-1900. From Santa Ana, California. County Surveyor, Orange County, California, 1900-01. Assistant Engineer, Temescal, Water Co., Corona, California, 1901; Transitman, San Pedro, Los Angeles, and Salt Lake Railroad Co., 1901-02; Assistant Engineer, Pacific Electric Railroad Co., Santa Ana, California, 1902.

ERLE D. MORTON. Etzatlan, Jalisco, Mexico.

Student, 1903-5. From Los Angeles, Cal. Assistant Superintendent of the Giroux Consolidated Mines Co., of Kimberley, Nevada, 1905-6; Washington University, 1906-7; Mine Examiner, Los Angeles, Cal., 1907-8; Surveyor, Amparo Mining Co., Etzatlan, Jalisco, Mexico, 1908.

WILLIAM FREDERICK MURRAY. Denver, Colorado.

Student, 1904-6. From Raton, New Mexico. In Chief Engineer's Office of the Victor Fuel Co., Denver, 1906-7; Assistant Engineer, Victor Fuel Co., 1907-8; Assistant to Chief and Traveling Engineer, Victor Fuel Co., and Colorado and South-Eastern Ry. Co., 1908.

PATRICK J. O'CARROL.*

(B. A. University of Dublin, Ireland.)

Graduate Student, 1898-9. From Dublin, Ireland. Mine Operator, Gallup, New Mexico, 1899-1901.

ALVIN OFFEN.*

Student, 1895-6. From Butte, Montana. E. M., 1896; Assistant Superintendent, Philadelphia Mine, Butte, Montana, 1896-7.

JUAN PALISSO. Mexico.

Student, 1903-4. From Barcelona, Spain, Mining Engineer, Mexico.

FOUNT RAY. Italy, Texas.

Student, 1991-2. From Waxahachie, Texas. General Manager, Lena Mining and Concentrating Co., Lordsburg, New Mexico, 1902; Cashier, Citizens National Bank, Italy, Texas, 1902.

ALBERT BRONSON RICHMOND. Patagonia, Arizona.

Student, 1900-01. From Las Priestas, Sonora, Mexico. Superintendent, Ramona Mill Co., Gairlon, Sonora, Mexico, 1901-02; Assayer, Patagonia Sampling Works, Patagonia, Arizona, 1902; Assayer and Metallurgist, Patagonia, Arizona; at present, General Manager, Mansfield Mining and Smelting Co., Patagonia, Arizona.

DELL FRANK RIDDELL. Parral, Mexico.

(Ph. G., Chicago College of Pharmacy, 1896; B. S., Nebraska State University, 1901; M. E. New Mexico School of Mines, 1905.)

Graduate Student, 1903-5. From Sioux Falls, South Dakota. Professor of Chemistry, Sioux Falls College, 1901-3; Instructor in Chemistry, New Mexico School of Mines, 1903-4; Acting Professor of Assaying, same, 1904-5; Holder of Allis-Chalmers Scholarship, 1905-6; at present Consulting Engineer, Parral, Mexico.

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* Deceased.

WILLIAM CARLOS STEVENSON.* Redlands, California.

Student, 1900-01. From Hillsboro, Ohio. General Manager, Mining Corporation, Albuquerque, New Mexico, 1901.

JOHN STUPPE. Torreon, Coahuila, Mexico.

Student, 1903-4. From El Paso, Texas. Accounting Department, El Paso Smelting Works, El Paso, Texas, 1896-1902; Metallurgical Department, Compania Metalurgica de Torreon, Torreon, Coahuila, Mexico, 1902.

LEO RICHARD AUGUST SUPPAN. St. Louis, Missouri.

(B. S. in Chemistry and Metallurgy, New Mexico School of Mines, 1896.)
Student, 1895-6. From St. Louis, Missouri. Instructor in Chemistry, New Mexico School of Mines, 1895-7; Graduate Student, Johns Hopkins University, 1897-8; Professor of Chemistry, Marine-Sims College of Medicine, St. Louis, 1898.

CHARLES L. SEARCY. Monterey, Mexico.

Student, 1903-4. From Peoria, Illinois. Mining Engineer, Monterey, Mexico.

CHARLES H. SHAMEL. Springfield, Illinois.

(B. S., M. S., University of Illinois; LL.B., University of Michigan; A. M., Ph. D., Columbia University.)
Graduate Student, 1901-2. Mining Lawyer, Springfield, Ill. Author of "Mining, Mineral and Geological Law," (1907).

OLIVER RUSSELL SMITH. San Bernardino, California.

(B. S., Kansas College of Agriculture and Mechanic Arts, 18ↄ8; C. E., New Mexico School of Mines, 1903.)
Graduate Student, 1899-1901. From Manhattan, Kansas. B. S., in Civil Engineering, New Mexico School of Mines, 1901; Assistant in Mathematics and Draughting, New Mexico School of Mines, 1900-01; Instructor in Engineering and Drawing, New Mexico School of Mines, 1901-2; Assistant-Professor in Engineering and Drawing, New Mexico School of Mines, 1902; Assistant-Surveyor, U. S. Land Office, 1902; City Engineer of Socorro, New Mexico, 1902; Deputy Mineral Surveyor, U. S. Land Office, 1903; Professor of Civil Engineering, New Mexico School ef Mines, 1902-7; Civil Engineer, Santa Fe R. R., San Bernardino, California, 1907.—

OTTO JOSEPH TUSCHKA. Monterey, Mexico.

(E. M. in Metallurgy, New Mexico School of Mines, 1897.)
Student, 1893-7. Assayer and Chemist, Graphic Smelting Works, Magdalena, New Mexico, 1897-8; Graduete Student, New Mexico School of Mines, 1898-99; Assistant Sampling-Mill Foreman and Chemist, Guggenheim Smelting and Refining Co., Monterey and Aguas Calientes, Mexico, 1899-1900; Assayer, Seamon Assay Laboratory, El Paso, Texas, 1900; Chief Chemist, Compania Minera Fundidora y Afinadora "Monterey," Monterey, Mexico, since 1900.

* Deceased.

MILTON BENHAM WESCOTT. Monterey, Mexico.

Student, 1904-5. From Chicago. Engineering Corps, Santa Fe Railroad, 1905; Assistant County Surveyor, El Paso County, 1906-7; Assistant Engineer, Monterey Railway, Light and Power Co., Monterey, Mexico, 1907; Assistant Engineer, Monterey Waterworks and Sewer Co., 1907-8; Resident Engineer, Monterey Water Works and Sewer Co., 1908.—

PATRICK ANDREW WICKHAM. Ray, Arizona.

Student, 1893-4. From Socorro, New Mexico. Assistant, Rio Grande Smelting Works, Socorro, New Mexico; Mechanical Engineer, Buckeye Mining Co., and Albemarle Mining Co., Bland, New Mexico, 1898-99; Mechanical Engineer, Mt. Beauty Mining Co., Cripple Creek, Colorado, 1899-1900; Engineer, Empire State Mining Co., Cripple Creek, Colorado, 1900-01; Engineer, Guggenheim Exporation Co. Minas Tecolotes, Santa Barbara, Mexico, 1901-02; Resident Engineer Independence Consolidated Mining Co., Independence, Colorado, 1902-4; Manager, Minas Dolores y Anexas, Dolores, Mexico, 1904-6; Assistant Superintendent, Kelvin-Calumet Copper Mining Co., Ray, Arizona, 1907.—

WAKELEY A. WILLIAMS. Grand Forks, British Columbia, Canada.

Student, 1893-4. From Council Bluffs, Iowa. Assistant Superintendent and Metallurgist, Granby Consolidated Mining, Smelting and Power Co., Grand Forks, 1898; at present, Superintendent of the same.

INDEX.

REGISTER

OF THE

NEW MEXICO SCHOOL OF MINES

1908-1909

SOCORRO, N. M.

MAIN BUILDING

ANNUAL REGISTER

OF THE

NEW MEXICO SCHOOL OF MINES

SOCORRO, N. M.

1908-9

WITH ANNOUNCEMENTS FOR 1909-10.

SANTA FE, N. M.:
THE NEW MEXICAN PRINTING COMPANY.
1909.

CALENDAR.

1909-1910.

First Semester:

September 13, Monday—Registration of students.
November 25 and 26, Thursday and Friday—Thanksgiving recess.
December 24, Friday—Christmas vacation begins.
January 3, Monday—Work resumed.
January 17-20, Monday to Thursday—Examinations.

Second Semester:

January 21, Friday—Registration of students.
February 22, Tuesday—Washington's birthday.
May 15-18, Monday to Thursday—Examinations.
May 20, Friday—Commencement.

FACULTY.

EMMET ADDIS DRAKE, A. B., A. M., *President of the Faculty, Professor of Languages.*

A. B., Wisconsin University, 1882; A. M., Wisconsin University, 1887; Assistant Engineer, Northern Pacific Railroad Co., 1882-1883; Instructor in Rhetoric and Oratory, Wisconsin University, 1883-1884; Instructor, Missouri School of Mines, 1884-1891; General Manager, Columbia Mining Co., 1891-1897; Professor of Languages, New Mexico School of Mines, 1897—; President of New Mexico School of Mines, 1908—; Editor Socorro Chieftain, 1900—.

REINOLD VERNON SMITH, B. S., *Professor of Mining and Metallurgy.*

B. S., University of Utah, 1905; Superintendent of Schools, Bingham, Utah, 1895-1896; Purchasing Agent, R. G., S. M. and P. Ry., Juarez, Mexico, 1896-1898; with Smith and Lyon, Mining Engineers, Salt Lake City, Utah, 1898-1900; Metallurgist, Dexter-Tuscarora Consolidated Gold Mining Co., Tuscarora, Nevada, 1900-1903; Metallurgist, Mercur Consolidated Gold Mining Co., Mercur, Utah, 1903; Metallurgical Engineer, Sevier Consolidated Gold Mining Co., Sevier, Utah, 1903-1904; Instructor in Chemistry and Physics, University of Utah, 1904-1906; Professor of Mining and Metallurgy, New Mexico School of Mines, 1906—.

ARTHUR KINNEY ADAMS, B. S., A. M., *Professor of Geology and Mineralogy.*

Student, Worcester Polytechnic Institute, 1900-1903; B. S., Harvard University, 1904; Assistant in Geology, 1904; Student, Harvard University Summer School, 1903, 1904; Graduate Student, 1905; A. M., Geology, 1905; Assistant on United States Geological Survey, 1905; Graduate Student in Mining Engineering and Assistant in Geology at Massachusetts Institute of Technology, 1905-1906; Assistant on United States Geological Survey, 1906-1907; Professor of Geology and Mineralogy, New Mexico School of Mines, 1907—.

GEORGE FREDERICK ECKHARD, B. S., *Professor of Civil Engineering.*

M. Di., Iowa State Normal School, 1900; B. S., University of Iowa, 1905; Instructor in Mathematics, Rock Rapids High School, 1900-1901; Instructor in Mathematics, Carroll High School, 1901-1902; with Wm. Schott Contracting Co., 1903; Illinois Central Railroad Co., 1904; Cuba Eastern Railway, 1905; Instructor in Cedar Falls High School and University of Iowa, 1906-1907; City Engineer of Socorro, 1907—; Professor of Civil Engineering, New Mexico School of Mines, 1907—.

LON CAIN WALKER, Ph. B., A. B., A. M., *Professor of Mathematics.*

Ph. B., Ohio University, 1893; Scholar in Mathematics, Nebraska University, 1893-1896; A. M., Nebraska University, 1896; A. B., Leland Stanford Junior University, 1901; A. M., Leland Stanford Junior University, 1902; Graduate Student, Colorado School of Mines, 1903-1904; Graduate Student, University of California, 1905-1906; County Examiner and Principal of New Madison, Ohio, Schools, 1889-1892; Teacher, Lincoln, Nebraska, High School, 1895-1896; Teacher of Mathemat-

ics, Montana State Normal School, 1898-1899; Assistant in Mathematics, Leland Stanford Junior University, 1899-1901; Teacher in Mathematics, Santa Barbara High School, 1904-1905; Teacher in Mathematics and Mechanics, Oakland Polytechnic College of Engineering, 1905-1907; Computer for Berkeley, California, Real Estate Syndicate, 1906-1908; Professor of Mathematics, New Mexico School of Mines, 1908—.

GEORGE IRVING KEMMERER, A. B., A. M., Ph. D., *Professor of Chemistry.*

A. B., University of Wisconsin, 1904; Graduate Student, University of Wisconsin, 1904-1906; A. M., University of Wisconsin, 1906; Graduate Scholar in Chemistry, University of Pennsylvania, 1906-1908; Ph. D., University of Pennsylvania, 1908; Chemist with Minnesota Iron Co., Summer, 1903; Assistant in Chemistry, University of Wisconsin, 1904-1906; Chemist and Photographer with the Wisconsin Geological and Natural History Survey, Summers of 1907 and 1908; Instructor in Chemistry, Temple University, 1907-1908; Professor of Chemistry, New Mexico School of Mines, 1908—.

JAMES PRESLEY ESKRIDGE, A. B., *Principal of the Academy.*

A. B., Park College, 1908; Assistant in Biology and Botany, Park College, 1906-1908; Principal of the Academy, New Mexico School of Mines, 1908—.

ANNE W. FITCH, *Registrar.*

NEW MEXICO SCHOOL OF MINES.

HISTORICAL SKETCH.

The New Mexico School of Mines was founded by act of the Legislature of 1889. This act provided for the support of the School by an annual tax of one-fifth of a mill on all taxable property.

Under an act of the Legislature, approved February 28, 1891, a board of trustees was appointed, an organization effected and immediate steps were taken towards the erection of necessary buildings. During this same year, a special appropriation of $4,000 was made for the partial equipment of the chemical and metallurgical laboratories.

Early in 1892, a circular of information, regarding the New Mexico School of Mines, at Socorro, New Mexico, was issued by the Board of Trustees. In this circular, the aims were fully set forth. The following year, a president was chosen and students in chemistry were admitted; but it was not until the autumn of 1895 that the mining school was really opened.

In 1893 a second special appropriation of $31,420 was made, to enable the School of Mines to be organized in accordance with the policy outlined by the act creating the institution.

By Act of Congress, approved June 21, 1895, the New Mexico School of Mines received for its share of certain grants of land, fifty thousand acres for its support and maintenance. From this source of revenue, the School has already received more than $17,000.

In 1899, the Legislature increased the former levy of one-fifth of a mill to twenty-seven and one-half one-hundredths of a mill.

In 1901, the Thirty-fourth General Assembly recognized the growing importance of the School by further increasing the tax levy to thirty-three one-hundredths of a mill. It also authorized the bonding of any portion of the grant of lands in order to more thoroughly equip the School with buildings and apparatus.

In 1903, the Thirty-fifth General Assembly raised the millage to forty-five hundredths of a mill. This, with greatly increased assessed valuation of property, doubled the income of the School over that of the previous year.

In 1905, an appropriation of $14,000 was made by the Legislature for the maintenance of the School.

In 1907, this appropriation was increased to $15,000, and an additional appropriation of $15,000 was made for the purpose of erecting a dormitory.

In 1909, the annual appropriation for the maintenance and support of the School of Mines was increased to $19,000.

STATUTES RELATING TO THE SCHOOL.

Some of the sections of the act creating the School of Mines are as follows:

The object of the School of Mines created, established and located by this act is to furnish facilities for the education of such persons as may desire to receive instruction in chemistry, metallurgy, mineralogy, geology, mining, milling, engineering, mathematics, mechanics, drawing, the fundamental laws of the United States and the rights and duties of citizenship, and such other courses of study, not including agriculture, as may be prescribed by the Board of Trustees.

The management and control of said School of Mines, the care and preservation of all property of which it shall become possessed, the erection and construction of all buildings necessary for its use, and the disbursement and expenditure of all moneys appropriated by this act, or which shall otherwise come into its possession, shall be vested in a board of five trustees, who shall be qualified voters and owners of real estate; and said trustees shall possess the same qualifications, shall be appointed in the same way, and their terms of office shall be the same, vacancies shall be filled in like manner, as is provided in Sections 9 and 10 of this act. Said trustees and their successors in office shall constitute a body under the name and style of "The Trustees of the New Mexico School of Mines," with right as such of suing and being sued, of contracting and being contracted with, of making and using a common seal and altering the same at pleasure, and of causing all things to be done necessary to carry out the provisions of this act. A majority of the board shall constitute a quorum for the transaction of business, but a less number may adjourn from time to time.

The immediate government of their several departments shall be intrusted to the several faculties.

The board of trustees shall have power to confer such degrees and grant such diplomas as are usually conferred and granted by other similar schools.

The trustees shall have power to remove any officer, tutor or instructor or employe connected with said school when, in their judgment, the best interests of said school require it.

The board of trustees shall require such compensation for all assays, analyses, mill-tests, or other services performed by said institution as they may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines for said institution, and an accurate account thereof shall be kept in a book provided for that purpose.

LOCATION.

The New Mexico School of Mines is located at Socorro, the county seat of Socorro County. Socorro is in the central part of the county and is on the main line of the Atchison, Topeka and Santa Fe Railway, 75 miles south of Albuquerque, and 180 miles north of El Paso. The Magdalena branch of the Santa Fe railway starts from this place.

Socorro is situated in the broad valley of the Rio Grande, at the foot of the Socorro range of mountains, the altitude of the town is about 4,600 feet above the sea and the location is pre-eminently pleasant and healthful. The air is exceedingly dry and the town has long been attractive to health-seekers who wish a mild and invigorating climate, and many persons every year have sought its hospitalities.

The scenery is quite diversified by plains, broad valley slopes, mesas, varied hill country and lofty mountains. In the city are two hotels and a number of good boarding houses. The churches represented are the Presbyterian, Roman Catholic and Episcopal.

Socorro has its own system of public water supply. The water is very soft and pure, and is furnished by hot springs which, four miles away, issue from the Socorro mountain. Two newspapers are published and a modern artificial ice plant and a large roller-process flouring mill are in operation.

The ground immediately adjacent to the School of Mines includes irrigable land, plateaus and mountain formations, all affording an excellent field for practice in surveying, the laying out of a railroad and irrigating canals, topography, mine engineering and geology, so that students can be prepared at the very door of the School in those branches which usually require tedious excursions from most other schools.

The New Mexico School of Mines enjoys the natural advantage

of being located in the midst of a region peculiarly rich in minerals of nearly all kinds, and is within easy reach of the most varied geological conditions, all of which are within a radius of thirty or forty miles of Socorro. Almost the entire geological column from the precious metal-bearing formations of the Archean to the coal beds of the Tertiary is here exposed. The industrial processes connected with mining and metallurgy may be seen admirably illustrated at Magdalena, Kelly, Rosedale, San Pedro, Hillsboro, Deming, Fierro, Silver City, Pinos Altos, Los Cerrillos, Gallup, Carthage, and elsewhere within easy reach of the School. These illustrate the most modern methods of mining, milling, ore-dressing, concentrating, smelting, lixiviation, cyaniding and other metallurgical processes.

A number of mines of various kinds, smelters, irrigating systems and other engineering works are accessible to the School. Within a few hours' ride by rail, are many important mining camps. The longer excursions bring the student to some of the most famous mines in southwestern United States. Some of the longest worked lodes in America are in this region. For more than 350 years, they have yielded their wealth to the European and, centuries before his advent, gave up even greater treasures to the native races.

If we look into the history of modern mining schools, we find that each becomes most celebrated along the line for which its locality is best known on account of its natural surroundings. Few institutions of learning are more dependent for success upon what may be called the accident of geographical location than the mining school. It may be truthfully said that no mining school is more fortunately situated so far as natural environment is concerned than that of New Mexico.

PURPOSE.

The ideal to which the New Mexico School of Mines tenaciously holds is the practical directing of young men to take active part in the development of the mineral wealth of our country and the world.

The New Mexico School of Mines is a Territorial Institution. It was established primarily to promote mining and mining interests in southwestern United States. However, it has a much wider scope, providing, as it does, adequate facilities for thorough training in the methods of modern mining, and meeting the demands for a mining education, not only from young men who are resi-

dents of New Mexico, but from students from other parts of the country desiring to avail themselves of the peculiar advantages of this region.

During the entire period of his training, the fact is impressed upon the student that intelligent mining is strictly a business operation, that mining is today as capable of being put on a secure business foundation as any manufacturing enterprises; that, from start to finish, it is a proposition akin to all the great business workings, such as enable the railroad train or the ocean liner to run with certainty and dispatch; that, while "lucky finds" will continue to be made, mining as a business is no longer a vast lottery, ever developing to their fullest extent the gambling propensities of mankind.

During the past quarter of a century, the development of the mineral wealth of the nation has been phenomenal and the calls for adequately prepared young men to direct mining enterprises in all their various ramifications have been rapidly increasing.

ADVANTAGES.

Several features contribute to the success of this institution as a school of mines.

The unique natural surroundings of the School, already described, create an invigorating mining atmosphere which is entirely wanting in situations away from the mines and mountains.

In the training offered by the School, there is noteworthy concentration of effort. There are many advantages in the direction of effort along few lines. In contrast with the many diversions that necessarily exist in most technical instituitons of learning, where all practical branches are equally represented, singleness of purpose is a leading feature in the New Mexico School of Mines. The conservation of energy growing out of the special method of instruction, happily adapts the student so that he gets the most out of his efforts.

The student is required as an integral part of his course to visit and critically inspect under the direct supervision of his instructors various plants and works, and to make intelligent reports. Being obliged from the start to make the most of the exceptional opportunities presented, he quickly falls into the spirit of his present and future work, and at once necessarily acquires for his chosen profession a sympathy that is seldom attained except after school days are over and after long and strenuous effort.

Being within short distances of mines and smelters, the student has the opportunity of finding regular employment during his vacation and of acquiring desirable experience in practical work.

The field for scientific research in New Mexico is unrivalled by any other mining region and the opportunities here offered are not neglected in the plan and scope of instruction. New Mexico, so far as concerns the mountainous portion, which comprises nearly two-thirds of its area and is nearly all mineral-bearing, is perhaps less known geologically than any other section of the United States. A little study of the plateau region of the northwestern portion of the territory has been made by the United States Geological Survey, but only in a general way. No attempt has ever been made, under government auspices, to investigate closely the geological structure of New Mexico mountains such as has been carried out in the other Rocky Mountain states, or to study the conditions of New Mexican mineral deposits, as has been done in Colorado by Emmons, in Nevada by Curtis, in California by Becker, and in other states by other distinguished investigators.

It is proposed that much of the advanced professional work of the School shall be of an original nature, to the end that the graduates may be skilled, theoretically and practically, in the very problems which they, as professional men, will be called upon to solve. This work will be carried on by the advanced students, under the direction of the professors, and will involve the collection of notes, sketches, maps and specimens, and the results of directed observation in all matters relating to the sciences and arts embraced in the courses of study. The subjects for such researches in geology and mining, and in the reduction of the ores of lead, silver, gold and copper are so numerous that it is impossible to do more here than to mention the fact that the conditions of climate, drainage, water-supply and geological structure in New Mexico differ greatly from the conditions existing in other parts of the Rocky Mountains, giving rise to new problems in practice. These problems are not by any means all that deserve attention. The investigations of the ores of iron, manganese, aluminum, cobalt, nickel, tin and quicksilver, together with the beds of coal, salt, alums, building stones, mineral-paints, cement-rocks, marls, etc., will be directly in line of the advanced laboratory work of the School, and every student who undertakes such work will be encouraged in every way possible to accomplish the best results.

ORGANIZATION.

The general management of the New Mexico School of Mines is vested in a Board of Trustees consisting of five members appointed by the Governor of the Territory with the concurrence of the Council for a term of four years. The Board of Trustees elects a president from its members and also a secretary and treasurer. The appointment of a president of the faculty of the School is also made by them.

By act of the Legislature, the maintenance of a preparatory department is required of the higher educational institutions of the Territory. The New Mexico School of Mines, therefore, is composed of the Academy and the College.

THE ACADEMY.

The requirements for admission to the Academy are the same as those for standard secondary schools. A two-year course is offered, the work therein corresponding to that of the ninth and tenth grades of the standard High school.

Especial stress is placed on work in English writing. It is being recognized that a most necessary part of a technical graduate's equipment is an ability to express himself in concise, consecutive, idiomatic language. Slovenly, inconsequential, ambiguous English in a report, a letter, an application, can readily lose a desirable position to an otherwise valuable technical man. Nowadays, men who can do must also be able to show in written language what they can do, what they are doing, or what they have done. There being in the College, at present, no space for courses of this nature, some vigorous training of the sort must be required in the preparatory years.

The courses offered in the Academy are:

FIRST YEAR—FIRST SEMESTER.

Elementary Algebra.

To the subject of simultaneous linear equations. Special drill is given in factoring.

Time: Five hours a week.

Text: Wells, *Algebra for Secondary Schools.*

English I.

The Merchant of Venice, Bunker Hill Oration, and Snowbound are read and discussed in class. Some memorizing of significant

passages is required. In the compositon work, an attempt is made to interest the student at once in narrative writing, fluency and correctness of expression being sought primarily. Later in the year the work verges into exposition. During this semester each student is required to read and pass an examination in two of the following supplementary books: Ivanhoe, Tales from Shakespeare, Autobiography of Franklin, Tom Brown's School Days, Robinson Crusoe, The First Jungle Book, and Pilgrim's Progress. Reading Course examinations are held about the middle of November and the first of January.

Time: Five forty-five-minute periods a week.

Text: Lockwood and Emerson, *Composition and Rhetoric.*

Latin I.

The work covers approximately the first one hundred and thirty pages of the text, comprising fifty-five lessons, with readings in the "Prose Selections" at the end of the volume.

Time: Five forty-five-minute periods a week.

Text: Collar and Daniell, *First Year Latin.*

Physical Geography.

Wherever possible, in this course, facts obtained by actual observation are made to verify and supplement the text used. There are daily assigned observations of clouds, winds and temperature, and a study of erosion by wind and by water and of geologic formation is made in excursions to near-by arroyos and canyons. In connection with the study of stream-flow, attention is called to the great importance of forest preservation to the people of the West.

Time: Five forty-five-minute periods a week.

Text: Tarr, *Elementary Physical Geography.*

Supplementary reading: Fairbanks, *Practical Physiography.*

FIRST YEAR—SECOND SEMESTER.

Elementary Algebra.

The first semester's work is continued through the subject of quadratic equations. Special attention is given to the statement of problems and to the solution of literal equations.

Time: Five hours a week.

English I.

A continuation of the first semester's work in this subject. Shakespeare's Tempest, Eliot's Silas Marner, and Bryant's Sella

and Thanatopsis are read and discussed in class. As in the first semester, each student is required to read and pass examination in two of the supplementary books offered in this course. These examinations will be given in March and May.

Latin I.

The text begun in the first semester is completed and thoroughly reviewed; the "Prose Selections" are finished and re-read.

Time: Five forty-five-minute periods a week.

Botany.

Plants, shrubs and flowers of the surrounding country are studied and analyzed. Germinating seeds and unfolding plants are studied, and considerable free-hand drawing, to aid the student to fix these observations in memory, is required. The evolutionary and inter-relating aspect of plant life is presented.

Time: Five forty-five-minute periods a week.

Text: Coulter, *Text-book of Botany.*

Supplementary reading: Stevens, *Introduction to Botany.*
Gray, *School and Field Botany.*
Bessey, *Botany.*

SECOND YEAR—FIRST SEMESTER.

Elements of Geometry.

The first three books of the text are completed. Nearly one-half of the time is devoted to the solution of original exercises in demonstration, construction and computation.

Prerequisite: Elementary Algebra.

Time: Five hours a week.

Text: Wells, *New Plane and Solid Geometry.*

English II.

Julius Caesar, Richard III, and the Letters of Washington are studied in class. The same plan is pursued in the writing work as in English I. This semester each student is required to read and pass examination in two of the following supplementary books: Tale of Two Cities, David Copperfield, Hoosier Schoolmaster, Last of the Mohicans, Vicar of Wakefield, and assigned portions from The Sketch Book. These examinations will be given as in English I.

Time: Five forty-five-minute perods a week.

Text: Scott and Denny, *Composition-Literature.*

Physics.

This course runs throughout the entire year, the aim being to familiarize the student with the principles of physics, and to serve as an introduction to applied mathematics. Attention is given to the preparation of records, and to the manipulation of apparatus. The splendid equipment of physical apparatus renders it possible to supplement the text by daily experiments and demonstrations. During this semester the subjects of mechanics and heat are treated.

Time: Five hours a week.

Text: Millikan and Gale, *First Course in Physics.*

Biology.

The work as outlined here pre-supposes a knowledge of elementary physiology. The aim is to familarize the student with the structure, function, and development of animals. The method of study is four-fold: First, careful observation of the specimen in hand, including dissecting and use of the microscope; second, pen-sketching of important organs; third, reference reading and discussion of obscure points; fourth, lectures and quizzes. Beginning with the study of protozoa in water the course is pursued through the study of the structure and functions of Sponges, Polyps and Medusae, Corals and Worms. A few slime-molds are included. The Metamorphosis of Insects and their adaptations to environment receive emphatic attention. The evolutionary aspects of animal life are stressed throughout.

Time: Four hours a week.

Texts: Jordan and Kellogg, *Animal Life.*
Sedgewick and Wilson, *General Biology.*
Marshall and Hurst, *Practical Zoology.*
Huxley, *Crawfish.*

SECOND YEAR—SECOND SEMESTER.

Elements of Geometry.

The remaining books of the text, including Solid Geometry, are completed.

Time: Five hours a week.

English II.

Macbeth, Henry V, The Idylls of the King, and the minor poems of Milton are studied in class. The remainder of the sup-

plementary books are treated as in English I. The writing work is a continuation of the first semester's methods.

Time: Five forty-five-minute periods a week.

Physics.

This is a continuation of the first semester's work. Electricity, sound, and light are treated in much the same manner as the subjects of the first half of the year.

Time: Five hours a week.

History.

For the benefit of those who have not had the opportunity to study Ancient History a brief review of that subject is made. Grecian and Roman History are given their proper emphasis. Special attention is paid to the History of Western Europe since the barbarian invasion, with emphasis on the bearing of old-world events upon the history of the Americas. In the study of such things as the mediaeval town, life in the feudal castle, and the Renaissance, an attempt is made to cause the student to realize these things as aspects of the daily existence of common men and women, which he would have lived likewise under like conditions, rather than to obtain a fixed mental chronology of dates and occurrences. Frequent written reviews are given throughout the course. Essays on certain assigned historical subjects are required.

Time: Five forty-five-minute periods a week.

Texts: Myers, *General History.*
Robinson, *History of Western Europe.*

THE COLLEGE.

The Requirements for Admission.

Candidates for admission to the College must show, either by examination or by the presentation of statements from schools of recognized standing, a satisfactory degree of proficiency in those subjects required in the Academy or in other subjects which are accepted as equivalent to the Academy subjects.

Registration.

No student will be permitted to register for any subject whose pre-requisites are not credited to him on the records of this school. Therefore students are advised not to delay either in making up any deficiencies which may exist or in obtaining, from this school, credits which may be due him for work done elsewhere.

Advanced Standing.

Credits for courses required in the College will be given to students either upon their passing an examination in such courses or upon their presentation of a certificate from an approved educational institution showing that they have satisfactorily completed such courses; provided, that no more than the first two years of the curriculum be thus credited to a student who has not yet received the bachelor's degree, and provided that no more than the first three years of the curriculum be thus credited to a student who has not yet received the engineer's degree. Certificates of credit for such courses must be presented, or examinations for credits must be arranged for, at or before the time of matriculation.

Irregular Students.

Students who are irregular, but who intend to graduate will be required to complete the courses in which they are delinquent as soon as possible and to become regular. It cannot be urged too strongly that students expecting to matriculate with this institution come prepared to take up the work without conditions. Every candidate for admission to the school may rest assured that after entrance his time will be fully occupied.

Special Courses.

Students not intending to graduate, but desiring to take special courses, may be registered for such courses; provided they give evidence of proficiency in the prerequisite subjects and provided their acceptance into such courses does not necessitate an unsatisfactory schedule of classes.

Curricula.

The curricula of the College are planned especially to meet the needs of students intending to engage in mining or metallurgical industries, in mine-experting or in surveying mines and mining lands. Accordingly, curricula are offered in the following:

MINING ENGINEERING.
METALLURGICAL ENGINEERING.
MINING GEOLOGY.
CIVIL ENGINEERING.

Each curriculum covers four years. Upon the satisfactory completion of either of them, the bachelor's degree is given. The Master's degree is conferred upon graduates of the School of Mines

who have spent two years in professional work, at least one of which must have been in a position of responsibility, and who present a satisfactory thesis.

In the adjustment of the courses of the several curricula, it is assumed that one hour's work in the class-room requires two hours of preparation, and therefore that one hour's work in the class-room is equivalent to three hour's work in the field or in the laboratory. In the following outlined statement of curricula, the number of hours per week required in the class-room (C. R.) and in the field or in the laboratory (F. & L.) are given separately. The number of hours required in the field or in the laboratory represents *average* time however, inasmuch as it is frequently advantageous, especially for field-work, to concentrate into one week an amount of work equal to that which would require two or more weeks if performed in separate installments.

MINING ENGINEERING.

MINING ENGINEERING.

FIRST YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK. C. R.	F. & L.
		FIRST SEMESTER.		
I.	1.	Advanced Algebra	5	
I.	2a.	Trigonometry	3	
III.	1.	Elements of Chemistry	5	6
V.	1.	Mechanical Drawing and Lettering		4
V.	2.	Descriptive Geometry		3
		SECOND SEMESTER.		
I.	3.	Analytic Geometry	5	
II.	1.	Mechanics, Molecular Physics, and Heat	3	3
III.	2.	Qualitative Analysis	1	9
V.	1.	Mechanical Drawing and Lettering		4
V.	3.	General Surveying	3	4

MINING ENGINEERING.

SECOND YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK. C. R.	F. & L.
		FIRST SEMESTER.		
I.	4.	Differential Calculus	5	
I.	11.	Theoretical Mechanics	5	
II.	2.	Power and Power Transmission	3	
III.	3.	Quantitative Analysis	1	6
V.	6.	Mine Surveying	2	4
VI.	1.	General Geology	2	3
		SECOND SEMESTER.		
I.	4.	Integral Calculus	4	
I.	12.	Applied Mechanics	5	
III.	4.	Wet Assaying		9
VI.	1.	General Geology	2	3
VI.	2.	Mineralogy	3	3

MINING ENGINEERING.

THIRD YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK. C. R.	F. & L.
		FIRST SEMESTER.		
I.	13.	Strength of Materials	5	
III.	5, 6.	Water and Fuel Analysis		6
V.	9.	Contracts and Specifications	2	
VI.	4.	Geological Mapping	1	4
VI.	7.	Lithology	2	3
VII.	1.	Mining A	4	
		SECOND SEMESTER.		
I.	14.	Hydromechanics	5	
V.	21.	Machine Drawing and Design	2	4
VII.	2.	Mining B	4	
VIII.	1.	Fire Assaying	1	8
VIII.	2.	General Metallurgy	3	

MINING ENGINEERING.

FOURTH YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK. C. R.	F. & L.
		FIRST SEMESTER.		
VI.	5.	Economic Geology A	3	
VII.	4.	Ore Dressing	4	
VII.	5.	Mine Plant	3	
VII.	7.	Design of Mine Plant		3
VII.	8.	Mine Constructions	3	8
VIII.	4.	Metallurgy of Copper	2	
		SECOND SEMESTER.		
VI	5.	Economic Geology A	3	
VII.	5.	Mine Plant	3	
VII	6.	Power Development and Transmission	1	
VII.	7.	Design of Mine Plant		3
VII.	8.	Mine Constructions	3	6
VII.	9.	Mine Administration and Accounts	2	
VII.	11.	Examination of Mines	1	6

METALLURGICAL ENGINEERING.

METALLURGICAL ENGINEERING.

THIRD YEAR.*

Course Numbers.	COURSES.	HOURS PER WEEK.	
		C. R.	F. & L.
	FIRST SEMESTER.		
I. 13.	Strength of Materials	5	
III. 5, 6.	Water and Fuel Analysis		6
III. 8.	Electro-Analysis	1	6
V. 9.	Contracts and Specifications	2	
VII. 1.	Mining A	4	
VIII. 3.	Furnaces	3	
	SECOND SEMESTER.		
I. 14.	Hydromechanics	5	
V. 10.	Masonry Construction	4	
V. 21.	Machine Drawing and Design	2	4
VIII. 1.	Fire Assaying	1	8
VIII. 2.	General Metallurgy	3	

*The courses of the first and second years are the same as those of the first and second years of Mining Engineering.

METALLURGICAL ENGINEERING.

FOURTH YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK. C. R.	F. & L.
		FIRST SEMESTER.		
III.	13.	Electric Furnaces	2	
VII.	4.	Ore Dressing	4	
VII.	8.	Mine Constructions	3	8
VIII.	4.	Metallurgy of Lead	3	
VIII.	5.	Metallurgy of Copper	2	
VIII.	9.	Metallurgical Plant	1	
VIII.	9.	Metallurgical Design		3
		SECOND SEMESTER.		
VII.	6.	Power	1	
VII.	8.	Mine Constructions	3	6
VII.	9.	Mine Administration and Accounts	2	
VIII.	6.	Metallurgy of Gold and Silver	5	
VIII.	7.	Metallurgy of Iron and Steel	4	
VIII.	9.	Metallurgical Design		6

MINING GEOLOGY.

MINING GEOLOGY.

THIRD YEAR.*

Course Numbers.	COURSES.	HOURS PER WEEK.	
		C. R.	F. & L.
	FIRST SEMESTER.		
III. 5, 6.	Water and Fuel Analysis		6
V. 4.	Topographical Surveying		6
V. 9.	Contracts and Specifications	2	
VI. 3.	Historical Geology	2	
VI. 4.	Geological Mapping	1	4
VI. 7.	Lithology	2	3
VI. 8.	Structural and Dynamical Geology	2	
VII. 1.	Mining A	4	
	SECOND SEMESTER.		
III. 7.	Advanced Analysis		6
VI. 6.	Economic Geology B	2	
VI. 11.	Petrography	2	4
VII. 2.	Mining B	4	
VIII. 1.	Fire Assaying	1	8
VIII. 2.	General Metallurgy	3	

*The courses of the first and second years are the same as those of the first and second years of Mining Engineering.

MINING GEOLOGY.

FOURTH YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK. C. R.	HOURS PER WEEK. F. & L.
		FIRST SEMESTER.		
VI.	5.	Economic Geology A	3	
VI.	9.	Geological Surveying	1	8
VI.	14.	Paleontology	2	3
VI.	15.	Abstracts	1	
VII.	4.	Ore Dressing	4	
VII.	5.	Mine Plant	3	
VII.	7.	Design of Mine Plant		3
		SECOND SEMESTER.		
VI.	5.	Economic Geology A	3	
VI.	12.	Ore Deposits	2	
VI.	16.	Valuation of Ore Deposits	2	6
VII.	5.	Mine Plant	3	
VII.	6.	Power	1	
VII.	7.	Design of Mine Plant		3
VII.	9.	Mine Administration and Accounts	2	
VII.	11.	Examination of Mines		8

CIVIL ENGINEERING.

CIVIL ENGINEERING.

SECOND YEAR.*

Course Numbers.		COURSES.	HOURS PER WEEK. C. R.	F. & L.
		FIRST SEMESTER.		
I.	4.	Differential Calculus	5	
I.	11.	Theoretical Mechanics	5	
III.	3.	Quantitative Analysis	1	6
V.	4.	Topographical Surveying		8
VI.	1.	General Geology	2	3
		SECOND SEMESTER.		
I.	4.	Integral Culculus	4	
I.	12.	Applied Mechanics	5	
V.	5.	Plotting Surveys		6
V.	10.	Masonry Construction	4	
VI.	1.	General Geology	2	3

*The courses of the first year are the same as those of the first year of Mining Engineering.

CIVIL ENGINEERING.

THIRD YEAR.

Course Numbers.		COURSES.	HOURS PER WEEK. C. R.	F. & L.
		FIRST SEMESTER.		
I.	13.	Strength of Materials	5	
V.	6.	Mine Surveying	2	4
V.	7.	Railway Curves	4	6
V.	11.	Sanitary Engineering	2	
V.	16.	Roads and Pavements	2	
		SECOND SEMESTER.		
I.	14.	Hydromechanics	5	
III.	7.	Advanced Analysis		6
V.	12.	Sewerage and Drainage	3	
V.	17.	Graphics	1	8
V.	18.	Stresses	4	

CIVIL ENGINEERING.

FOURTH YEAR.

Course Numbers.	COURSES.	HOURS PER WEEK.	
		C. R.	F. & L.
	FIRST SEMESTER.		
III. 5, 6.	Fuel and Water Analysis		6
V. 9.	Contracts and Specifications	2	
V. 13.	Water Supply	3	
V. 14.	Hydraulics	4	
V. 15.	Geodetic Surveying	2	
V. 19.	Structural Details		6
VII. 1.	Mining A	4	
	SECOND SEMESTER.		
V. 8.	Railway Location.	5	
V. 19.	Structural Details		6
V. 20.	Concrete Structures	5	
V. 21.	Machine Drawing and Design	2	4
VII. 6.	Power	1	

DEPARTMENTS OF INSTRUCTION.

I. DEPARTMENT OF MATHEMATICS AND MECHANICS.

LON C. WALKER, Professor.

Mathematics.

Constituting as they do the foundation of the several curricula offered by the School, the various subjects in mathematics are given first attention. These subjects have been arranged to meet the extensive needs of students in the various branches of engineering, and are treated so as to give the student both logical training and power of application. Care is taken to present both underlying principles and a great variety of concrete applications, the latter connecting the mathematical instruction closely with the professional studies. The study of mathematics is emphasized as a necessary basis for further instruction in the engineering courses. The principles which are of greatest value in engineering work are particularly emphasized. The courses offered serve as a sufficient preparation for the work in mathematical physics, physical chemistry, engineering, applied mechanics, and other physical sciences. They mark the minimum of mathematical attainments that an engineer ought to possess. Every student is required to have a good, practical knowledge of the subjects taught. Frequent written reviews test the student's proficiency.

The course in mathematics pre-supposes a thorough knowledge of elementary algebra through quadratic equations, and of plane and solid geometry.

1. Advanced Algebra.

This course covers a review of quadratic equations, graphical representation, simultaneous quadratic equations in two variables, bi-nominal theorem, progressions, complex numbers, partial fractions, logarithms, inequalities, variation, and theory of equations.

Prerequisites: Entrance requirements.

Time: Class-room, five hours a week, first semester.

Text: Hawkes, *Advanced Algebra.*

2a. Plane Trigonometry.

A combination of the ratio and line systems is used. Special attention is given to the transformation of trigonometric expres-

sions and to practice with applications involving logarithmic calculation.

Prerequisites: Entrance requirements.
Time: Class-room, three hours a week, first semester.
Texts: Granville, *Plane Trigonometry.*
Bremiker, *Tables of Logarithms.*

2b. Spherical Trigonometry (Optional).

This course includes the solution of spherical triangles, and the application of spherical trigonometry to the simple problems of spherical astronomy.

Prerequisites: Courses 1 and 2a of this department.
Time: Class-room, one hour a week, one semester.
Texts: Granville, *Spherical Trigonometry.*
Bremiker, *Tables of Logarithms.*

3. Analytic Geometry.

The subject is developed after the Euclidean method of definition and theorem. Each method is summarized in a rule stated in consecutive steps. The analytic geometry of the straight line, the circle, and the conic sections is covered. Enough solid analytic geometry is given to merely acquaint the student with co-ordinates in space and with the relations betwen surfaces, curves, and equations in three variables.

Prerequisites: Courses 1 and 2a of this department.
Time: Class-room, five hours a week, second semester.
Text: Smith and Gale, *Introduction to Analytic Geometry.*

4. Calculus.

The subjects treated are the development of the basic principles, and the formulas of the calculus; differentiation of functions, development of functions into series, evaluation of indeterminate forms; maxima and minima, lengths of curves, areas, volumes, centres of gravity, and moments of inertia. Special attention is given to the applications of the methods of differentiation and integration to problems in geometry, mechanics and engineering subjects.

Prerequisites: Courses 1, 2a and 3 of this department.
Time: Class-room, five hours a week, one year.
Texts: Granville, *Differential and Integral Calculus.*
Pierce, *A Short Table of Integrals.*

5. Differential Equations (Optional).

The primary object of this course is to make the student famil-

iar with the principles and devices that will enable him to integrate most of the equations he is apt to come across. As much of the theory is given as is likely to be comprehensible to the student who has had a year's course in the Differential and Integral Calculus. Numerous applications to problems in geometry and physical sciences are introduced.

Prerequisites: Courses 1, 2a, 3 and 4 of this department.
Time: Class-room, five hours a week, one semester.
Text: Cohen, *Differential Equations.*

6. Solid Analytic Geometry (Optional).

The elementary parts of this subject are presented in as simple a manner as possible. The same methods are used uniformly for the plane and for space. In this way the extension to three dimensions is made easy and profitable. The different surfaces which can be represented by the general equation of the second degree are discussed at an earlier stage than is sometimes adopted. Emphasis is everywhere put upon the analytic side, that is, the student is taught to start from the equation. He is shown how to work with the figure as a guide, but is warned not to use it in any other way.

Prerequisites: Courses 1, 2a, 3 and 4 of this department.
Time: Class-room, four hours a week, one semester.
Texts: C. Smith, *Solid Geometry.*
W. S. Aldis, *Solid Geometry.*

7. Mathematical Astronomy (Optional).

This course is intended to give the student practical knowledge of those principles of astronomy which are the foundation of geodesy. It comprises discussions of the sun, planets, satellites, and stars; of their apparent motions and the determination of their positions in the celestial sphere. The adjustments and uses of astronomical instruments are explained. Special attention is given to the methods of determining latitude, time, and azimuth.

Prerequisites: Courses 1, 2a, 2b and 3 of this department.
Time: Class-room, three hours a week, one semester.
Texts: Young, *General Astronomy.*
Barlow, *Mathematical Astronomy.*

8.—Method of Least Squares (Optional).

Observation errors and the determination of true value from numerous observations; residuals, weights, normal equations for

determining average value; conditonal observations, probable error, interpolation formulas.

Prerequisites: Courses 1, 2a, 3 and 4 of this department.

Time: Class-room, two hours a week, one semester.

Text: Johnson, *Least Squares.*

9. Geodesy (Optional).

The earth, planets, satellites, and stars, their astronomical positions and apparent motions, computation of right ascension and declination, description, adjustment, and use of the sextant, astronomical transit, zenith-telescope and azimuth, and their applications to the determination of time and terrestrial latitude, longitude, and azimuth.

Prerequisites: Courses 1, 2a, 2b, 3, 7 and 8 of this department.

Time: Class-room, five hours a week, second semester.

Text: Hayford, *Geodetic Astronomy.*

MECHANICS.

The work in mechanics is divided into two more or less distinct parts—theoretical and applied mechanics. The subject matter is selected with special reference to the needs of engineering students. The primary aim is to supply for students beginning the study of mechanics a course of such a nature as shall emphasize the fundamental physical principles of the subject.

The work is so planned as to impart to the student a thorough knowledge of such principles as will be of practical use in engineering. Particular attention is given to the solution of problems which involve the application of these principles in engineering practice. A course in mechanics of materials is also given, as this is fundamental to all designing and structural work.

10. Elementary Mechanics.

This course co-ordinates with the work in mathematics and physics, and covers the elements and fundamental principles that form the basis of every engineer's knowledge. Students are taught to solve numerous problems that present important facts illustrative of every-day engineering practice. On the theoretical side, practically all the topics treated have a direct bearing in engineering problems. Special prominence is given to those results which it is the most important to make familiar to the student of applied mechanics.

Prerequisites: Courses 1 and 2a of this department.

Time: Class-room, three hours a week, second semester.
Texts: Franklin and MacNutt, *Elements of Mechanics.*
Sanborn, *Mechanics' Problems.*
Morley, *Mechanics for Engineers.*

11. Theoretical Mechanics.

Besides illustrating the principles of kinematics and kinetics the object is to explain the application of pure mathematics and thus give the student confidence in its use. The course is designed as a preparation for the courses in applied mechanics.

Prerequisites: Course 4 of this department must precede or accompany.
Time: Class-room, five hours a week, first semester.
Texts: Smith and Lester, *Theoretical Mechanics.*
Sanborn, *Mechanics' Problems.*

12. Applied Mechanics.

This course co-ordinates with the several engineering departments. Each principle developed is followed by a number of applications. The illustrations deal with matters that directly concern the engineer. The topics treated are concurrent forces, moment of inertia, flexible cords, rectilinear motion, curvilinear motion, rotary motion, dynamics of machinery, work and energy, friction, and impact.

Prerequisites: Integral Calculus must precede or accompany.
Time: Class-room, five hours a week, second semester.
Text: Hancock, *Applied Mechanics for Engineers.*

13. Strength of Materials.

This course is given with the view of the development of special rules applied to the structural forms in common use. An effort is made to direct the student to some knowledge of the general fundamental principles upon which these rules are based, in order that he may be in a position to treat new problems as they arise. The laws of stresses and deformations in different materials are discussed, and the method of determining the shearing forces and bending moments in beams are explained. Hooke's law and Bernoulli's assumption are presented in detail, and special emphasis placed on the limitations to their validity. Special applications of the above laws are made in the solution of numerous problems of a practical character.

Prerequisites: Courses 4, 11 and 12 of this department.
Time: Class-room, five hours a week, first semester.
Texts: Slocum and Hancock, *Strength of Materials.*
Shepard, *Problems in the Strength of Materials.*

14. Hydromechanics.

This course is designed to give the student a working knowledge of the mechanics of fluids. This is a subject of growing practical importance, owing to the increased development of water power in recent years.

The fundamental principles of the theory of hydraulics are studied and some of the most important applications of these principles are explained. The course covers pressure of fluids in tanks and reservoirs, earth pressure and retaining walls, immersion and flotation, gaseous fluids, steady flow of liquids through pipes and orifices, steady flow of water in open channels, dynamics of gaseous fluids, impulse and resistance of fluids.

Prerequisites: Courses 4, 11, 12 and 13 of this department.
Time: Class-room, five hours a week, second semester.

15. Celestial Mechanics (Optional).

The aim is to offer such a course that one who has had the necessary mathematical training may obtain from it in a relatively short time and by the easiest steps a sufficiently broad and just view of the whole subject to enable him to stop with much of real value in his possession, or to pursue to the best advantage any particular portion he may choose. This course includes an investigation of the fundamental equations of motion and of the formulae for determining the positions of bodies revolving about the sun.

Prerequisites: Courses 4, 5, 7, 11 and 12 of this department.
Time: Class-room, five hours a week, one semester.
Texts: Moulton, *An Introduction to Celestial Mechanics.*
Watson, *Theoretical Astronomy.*

II. DEPARTMENT OF PHYSICS.

REINOLD V. SMITH, Professor.

1. General Physics.

Mechanics, molecular physics and heat are studied.

The class work consists of lectures, demonstrations, recitations and the solution of assigned problems.

The laboratory work is so arranged as to exemplify the principles discussed in class and is quantitative in character, the qualitative experiments being performed in the class-room. The laboratory work consists of the following experiments: (1) Uniformly accelerated motion; (2) Relation of force to mass and to acceleration; (3) Composition and resolution of forces; (4) Moments; (5) Energy and efficiency; (6) Inelastic impact; (7) Elastic impact; (8) Young's modulus; (9) Moments of torsion and coefficients of rigidity; (10) Moment of inertia; (11) Simple harmonic motion; (12) Centripetal force; (13) Pressure-expansion of gases; (14) Heat-expansion of gases; (15) Archimedes's principle; (16) Calorimetry.

This course is intended not only to familiarize the student with the manner of making accurate determinations, of properly manipulating and adjusting the instruments used in making precise measurements, and of intelligently recording, interpreting and reducing the data obtained, but also to give him a better understanding of the laws of physics and of the real significance of physical constants.

Prerequisite: Course 2a of Department I.
Time: Class-room, three hours a week, second semester.
Laboratory, three hours a week, second semester.
Texts: Millikan, *Mechanics, Molecular Physics and Heat.*

2. Power and Power Transmission.

The various sources of power are discussed briefly, steam and other heat engines as the great sources of power being studied in considerable detail; the boiler and furnace with their accessories; the engine with its connections and controlling mechanism.

Lectures are given on the transmission of power by shafting, gearing and compressed air; water-power and electric transmission

and distribution of power; the general principles of the transmission and transformation of electrical energy.

Prerequisite: Course 1 of this department.

Time: Class-room, three hours a week, first semester.

Texts: Kerr, *Power and Power Transmission.*
Hutton, *Mechanical Engineering of Power Plants.*

III. DEPARTMENT OF CHEMISTRY.

George Kemmerer, Ph. D., Professor.
T. H. Bentley, Laboratory Assistant.

The excellent equipment of the chemical laboratory (elsewhere described) makes it possible to offer a number of advanced courses essential to chemical engineering, in addition to those required by the curricula already outlined. These courses are designated *special* and will be given upon the request of a sufficient number of students.

It is the intention to secure as perfect a correlation as possible between the lectures, the quizzes, and the laboratory-work, in order that the greatest efficiency in instruction may be attained.

1. Elements of Chemistry.

This course is introductory to all engineering, metallurgical, and geological courses and is intended to give the student a broad view of the field of inorganic chemistry by presenting to him the fundamental laws and theories of chemistry and by acquainting him with the occurrence, preparation, properties, relations and uses of the common elements.

The class-room work consists of lectures in which the chemistry of the elements and their compounds is simplified as much as possible. The more important reactions and theories are illustrated with lecture-table experiments and immediately following the class-room work each student performs as many experiments as possible in the laboratory, carefully recording the results. These records are then corrected by the instructor and returned to the student. Once each week the students are quizzed on both the class-room and laboratory work and once each month the work is reviewed in a written test.

Time: Class-room, five hours a week, first semester.
Laboratory, six hours a week, first semester.

Texts: Newth, *Inorganic Chemistry.*
Alex. Smith, *General Inorganic Chemistry.*
L. Leneher, *Laboratory Experiments in General Chemistry.*

2. Qualitative Analysis.

Those reactions which are used in the separation and detection of the metals of the silver group are carried out in the laboratory

and discussed in the class-room. When sufficient familiarity with these reactions has been acquired, unknown solutions containing one or more metals of this group are then analyzed and the metals detected. The metals of the copper group are then studied similarly and unknown solutions containing the metals both of the silver and copper groups are analyzed. In this manner are studied the metals of all the groups and finally the acids. When entirely familiar with the analytical procedure both for metals and acids, the student is required to analyze several of the following substances: Alloys, insoluble salts, industrial products, minerals, slags, mattes, and speisses.

Prerequisite: Course 1 of this department.

Time: Class-room, one hour a week, second semester.
Laboratory, nine hours a week, second semester.

Text: Treadwell & Hall, *Analytical Chemistry, Vol. I.*

3. Quantitative Analysis.

A course embodying the general principles of quantitative analysis and introductory to those courses involving special quantitative methods.

In the laboratory the following experiments are performed:

Gravimetric: Determinations of chlorine in a chloride, of iron in iron wire on in ferrous ammonium sulphate, of sulphur in a sulphate, of phosphorus in apatite, of copper (electrolytically) in brass, of silica in feldspar.

Volumetric: The preparation of half-normal solutions of an acid and of an alkali, the determination of the strength of some acid or alkali, the determination of iron in an ore by the permanganate method, and the determination of silver in an ore by Volhard's method.

The class-room work consists in lectures on the use and care of balances, crucibles and desiccators, on the selection and use of indicators, on the use, care, and calibration of volumetric flasks, burettes, and pipettes, on the methods used in the laboratory from the standpoint of modern chemical theories, in quizzes on these topics, and in the solution of stoichiometric problems involving calculations which are similar to those arising from, and essential to, the laboratory experiments.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, one hour a week, first semester.
Laboratory, six hours a week, first semester.

Texts: Treadwell & Hall, *Analytical Chemistry, Vol. II.*
Fresenius, *Quantitative Chemical Analysis.*

4. Wet Assaying.

A thoroughly practical course in the determination of the important constituents of ores and metallurgical products. The methods taught are those in use in the large smelters of the West. The student works upon checked samples of widely varying composition until he becomes familiar with the various methods and can carry them out under all conditions with accuracy and rapidity.

A large collection of accurately checked samples is available for analysis, including many obtained from the principal smelters of the country. The regular work of the course consists in the assaying of typical ores and metallurgical products. By putting in extra time the ambitious student may greatly increase the number of his determinations and thus become decidedly more expert in this work.

The following determinations are made: Arsenic, silver, copper (both by the cyanide and iodide methods), lead by the molybdate method, zinc by the ferrocyanide methods, manganese and calcium by the permanganate method.

Prerequisites: Course 3 of this department.

Time: Laboratory, nine hours a week, second semester.

Text: Low, *Technical Methods of Ore Analysis.*
Sutton: *Volumetric Analysis.*

5. Fuel Analysis.

Analyses of various coals or of other fuels are made and their heat-values are then calculated from these analyses and also determined experimentally by means of the calorimeter. Flue-gases are analyzed and the results are interpreted. The flash-point, burning point, specific gravity, viscosity, and acidity of oils are determined.

Prerequisite: Course 3 of this department.

Time: Laboratory, six hours a week, seven weeks of second semester.

Texts: Stillman, *Engineering Chemistry.*
Hempel, *Gas Analysis.*

6. Water Analysis.

Analyses of waters are made in regard to their possible use in boilers. These analyses involve determinations of total solids,

organic and volatile matter, silica, aluminum and iron, calcium, magnesium, sodium and potassium, and carbonic, sulphuric and hydrochloric acids.

Prerequisite: Course 4 of this department.

Time: Laboratory, last ten weeks of second semester.

Texts: Stillman, *Engineering Chemistry.*
Fresenius, *Quantitative Chemical Analysis.*

7. Advanced Quantitative Analysis.

This course is a continuation of Course 3 or it may be substituted for Course 8. The work will be chosen to suit the needs of each student.

Prerequisite: Course 3 of this department.

Time: Laboratory, six hours a week, one semester.

8. Electrolytic Analysis.

This course will deal with the determination of the more important metals such as copper, lead, zinc, and silver by both the rapid and ordinary electrolytic methods.

The course may be substituted for Advanced Quantitative Analysis, Fuel and Water Analysis, or taken as special.

Time: Class-room, one hour a week, one semester.
Laboratory, six hours a week, one semester.

Text: Edgar V. Smith, *Electro Analysis.*

9. Inorganic Preparations. (Special.)

Chemically pure substances of commercial importance are prepared by the student with constant attention to the securing of maximum yields. Skill in manipulation is encouraged, methods of manipulation not occurring in other courses are practiced, and a general increased knowledge of inorganic chemistry is acquired.

Prerequisite: Course 2 of this department.

Time: Class-room, one hour a week, one semester.
Laboratory, six hours a week, one semester.

10. Industrial Inorganic Chemistry. (Special.)

The utilization of inorganic materials in manufacturing processes was taken up in an elementary way in connection with general chemistry. This special industrial course goes into the subject considerably more in detail. The manufacturing processes considered are mainly those of acids, alkalies, mineral dyes, mineral paints, explosives and matches.

The aim is to expound the dominant principles underlying each process rather than to present such an account of the details as will suffice for the student of any particular industry. In this manner, the student is prepared to study efficiently the literature of any branch in which he may afterwards become especially interested.

Prerequisites: Courses 1 and 2 of this department.
Time: Class-room, two hours a week, one semester.
Text: Thorp, *Outlines of Industrial Chemistry.*

11. Organic Chemistry. (Special.)

This course serves as an introduction to the study of the hydrocarbons of both the fatty and the aromatic series, alcohols, phenols, aldehydes, organic acids, ethers, esters, and carbohydrates. Their formation, relations, and derivatives are discussed, and special attention is given to the explanation of familiar organic phenomena.

Prerequisites: Courses 1 and 2 of this department.
Time: Class-room, two hours a week, one year.
Laboratory, six hours a week, one year.
Texts: Cohen, *Theoretical Organic Chemistry.*
Gatterman, *Practical Methods of Organic Chemistry.*

12. Physical and Theoretical Chemistry. (Special).

The elements of theoretical chemistry have already been studied in the courses in general chemistry, qualitative and quantitative analysis. The subject is here pursued more exhaustively. The principal subjects considered are: The gas laws, atomic and molecular weights and the methods of determinng them, forms and the phase rule, the kinetic theory, thermochemistry, ionization, dissociation and balanced actions, electro-chemistry and photo-chemistry.

Prerequisite: Course 3 of this department.
Time: Class-room, two hours a week, one semester.
Text: Walker, *Physical Chemistry.*

13. Electric Furnaces.

The course is designed to furnish the metallurgist and chemist with a knowledge of the practical application of the electric furnace. A small amount of time will be devoted to the history and development of the electric furnace, after which the types of fur-

naces will be studied with special reference to their industrial application in metallurgical and chemical processes.

Time: Class-room, two hours a week, one semester.

Text: Wright, *Electric Furnaces and Their Industrial Application.*

14. Elements of Practical Photography. (Special.)

The course is planned to furnish the engineer with a working knowledge of photography such as will enable him to use the camera intelligently as an aid in his engineering work.

The class-room work will consist of one lecture a week which will be supplemented by laboratory work in which each student will be required to take and finish a good negative, velox print, platinum print, lantern slide, and bromide enlargement.

Time: Class-room, one hour a week, second semester.

IV. DEPARTMENT OF LANGUAGES.

EMMET ADDIS DRAKE, Professor.

A speaking knowledge of Spanish has recently become a great advantage, if not a necessity, to a large percentage of the young men who engage in any of the lines of work for which they may fit themselves at the School of Mines. For that reason special attention is given to the study of the language at this institution. The course offered continues through two years and is designed to give the student a practical speaking knowledge of Spanish. The location of the New Mexico School of Mines affords an unsurpassed opportunity for acquiring this knowledge; for, in Socorro and vicinity, Spanish is as generally spoken as English.

Either French or German may be taken in place of Spanish if a sufficient number of students apply.

The courses in German continue through two years. No particular attention is given to the speaking or writing of this language. The chief aim is to put the student into possession of a useful instrument for his major line of work.

The importance of a reading knowledge of both German and French cannot be emphasized too strongly, as a vast store of information necessary to the engineer and scientist is locked up in these languages. By the end of the second year the student should be able to read readily the scientific and technical books which are of use to him in his work.

The course offered in French continues through two years. The chief aim in this course, as in the course in German, is to give the student such a reading knowledge of the language as will be of practical use to him in the pursuit of his special line of work. At the end of the course, the student is expected to be able to read French with sufficient ease to use French text-books and other publications in the pursuit of his technical studies.

1. Spanish.

The work is based on Worman's First and Second Spanish Readers. A part of the class exercises each day consists in cross-translations, both oral and written. Special stress is placed upon conversational exercises. Attention is given to the elementary principles of the grammar of the language, especially to conjugation.

Time: Two and a half hours a week, one year.
Texts: Worman, *First and Second Spanish Readers.*
Garner, *Spanish Grammar.*

2. Spanish.

Alarcon's *El Capitan Veneno,* and Valera's *El Pajaro Verde* are read. The study of Spanish grammar is pursued systematically, Garner's *Spanish Grammar,* being used as a text. Two periods each week are devoted to converstion in Spanish and to cross-translation, no particular text-book being used in this work.
Prerequisite: Course 1 of this department.
Time: Two and a half hours a week, one year.

3. German.

The first year's work in this course is elementary. It consists of study of grammar and easy readings. Practice in speaking and writing the language is not insisted upon any further than is needed in fixing the main principles of construction in the mind.
Time: Two and a half hours a week, one year.

4. German.

The second year's work in German consists in the reading of narrative and descriptive modern prose and a drama of Lessing or Schiller. The study of grammar is continued. Sight-reading forms a large part of the exercises of the second term. The reading texts are changed from year to year to avoid repetition and to give students who may desire an opportunity to take more than the required amount of German.
Time: Two and a half hours a week, one year.

5. French.

The first year's work is elementary. Fraser and Squair *French Grammar* and *Le Roman d'un Jeune Homme Pauvre* form the basis of the work. The text-book for reading is changed from year to year, however, to give students who may wish it an opportunity to read more than the required amount of French. Easy readings are assigned for work outside the class-room with a view to examination.
Time: Two and a half hours a week, one year.

6. French.

Effort is still concentrated upon reading. The student is expected to be able at the end of this course to read with sufficient

ease to make practical use of French text-books and periodicals in his other studies. The study of grammar is continued. *La Petite Fadette, Le Cid, Le Misanthrope* and *Athalie* are the texts from which the readings are selected.

Time: Two and a half hours a week, one year.

V. DEPARTMENT OF CIVIL ENGINEERING.

GEORGE F. ECKHARD, Professor.

In Civil Engineering, the first three years are devoted to the mastery of those sciences upon which all professional engineering practice is based. In addition to a thorough mathematical training, particular care is taken to familiarize the student with the construction, care and use of engineering instruments. To this end, in addition to the regular class-room work, much time is given to field work, wherein a great variety of practical problems are treated. Attention is also given to the study of engineering materials and their adaptation to various structures.

In the post-graduate work of the fourth year the student is offered several branches in which he may specialize. These are Structural Engineering, Sanitary Engineering, and Hydraulic and Irrigation Engineering. The work of this year is largely drawing and design, intended to prepare the student for practice along one of these lines.

The School offers great advantages in the line of Hydraulic and Irrigation Engineering. Besides being situated in a distinctly irrigation country, it is also in reasonable proximity to two of the largest projects of the United States Reclamation Service, where the latest and best methods may be studied.

Students have usually been able to attach themselves during the summer vacation to the regular surveying parties of railway, irrigation or mining companies, the United States Land Offices, or the United States Geological Survey.

1. Mechanical Drawing and Lettering.

This course comprises the drawing of 20 plates in the geometrical representation of objects by isometric and orthographic projections. Objects in various positions are projected orthographically and the relations between the different views are brought out; sections at different positions and the intersections of solids are represented. The principles of linear perspective are discussed and applied to the representation of some simple objects.

The latter part of the semester is devoted to special practice in lettering and in the construction of appropriate and attractive letters for maps and engineering plans.

Prerequisite: Entrance requirements.

Time: Laboratory, four hours a week, one year.
Text: Tracy, *Mechanical Drawing.*

2. Descriptive Geometry.

The representation of all geometrical magnitudes by means of orthographic projection, the solution of problems involving points, lines, surfaces and solids, descriptions of and problems relative to warped and double-covered surfaces, intersections of lines and surfaces.

Prerequisite: Entrance requirements.
Time: Laboratory, three hours a week, first semester.
Text: Church, *Descriptive Geometry.*

3. General Surveying.

The introductory course in surveying deals with the principles of land-surveying, the instruments used both in the field and in the office, their adjustments and their proper care. The transit, level, solar compass, and plane-table are discussed in detail and their uses in the various problems of land, mine, and hydrographic surveying are illustrated by numerous practical problems and field exercises.

In the field-practice, each student becomes thoroughly familiar with the laying out with compass and chain of small land holdings, the survey of urban lots and streets by means of transit and steel-tape, location of mining claims, and similar work. Observations are made on the polar-star for the purpose of determining the true meridan. Latitude, azimuth and time by direct solar observations are determined. Triangulation, both primary and secondary, from a measured base-line is carefully worked out. Measurements are made of mountain heights by triangulation methods. The various methods of mapping are considered in detail.

Prerequisites: Course 2a of Department I.
Time: Class-room, three hours a week, second semester.
Field and laboratory, four hours a week, second semester.
Text: Raymond, *Text-Book of Plane Surveying.*

4. Topographical Surveying.

This course is intended to give the student thorough drill in stadia methods, especially as applied to rapid topographical surveying. The theory of the stadia is first discussed, after which a complete stadia survey of a broken area of land is made. Great

stress is laid on the careful taking of notes with reference to their use in Course 6 of this department, for the study of the manner of reduction and of the most approved methods of plotting survey notes.

Prerequisite: Course 3 of this department.

Time: Field, eight hours a week, first semester.

5. Plotting Surveys.

The early part of the semester is devoted to mapping general land surveys made by the student himself or from notes furnished him. Bearings or azimuths of courses are laid off both by protractor and by coordinates, and errors in closure are discussed and illustrated. In general, areas are computed by latitudes and double meridian distances, and by the method of rectangular coordinates of the corners. The topographical survey of Course 5 is plotted, all contour lines, streams, roads, fences and buildings being properly shown. The nature of the soil and vegetation is indicated by the conventional topographical symbols, thus making a complete and accurate map of the area surveyed. In plotting stadia work, special attention is given to rapid methods of reducing and plotting inclined stadia readings. The mechanical reproduction of maps to different scales and the evaluation of irregular areas are discussed.

Prerequisites: Courses 3 and 4 of this department.

Time: Laboratory, six hours a week, second semester.

6. Mine Surveying.

The work consists of lectures, field-practice and office-work. The field-practice embraces both surface location of claims and top-works, and the underground excavations.

In the location of mining claims, a complete survey is made for the purpose of patenting, in accordance with the requirements of the Surveyor General's Office. It includes all the methods followed by United States mineral surveyors. The law relating to surveys for the patenting of mining properties is treated in detail.

In the underground surveying, particular attention is given to physical difficulties met with and unusual obstacles to be overcome. Among the special topics that are dwelt upon at length are the location of underground stations, connection of surface and subterranean workings through slopes and shafts, graphic methods of keeping notes, preparation of mine-maps by method of eo-ordinates, preservation of maps and permanent records.

In the field-practice, several mines of different types are surveyed, full notes taken and maps made.

Prerequisite: Course 3 of this department.

Time: Class-room, two hours a week, first semester.
Field-practice and office-work, four hours a week, first semester.

Text: Underhill, *Mineral Land Surveying.*

7. Railway Curves and Earthwork.

A study of simple, compound, and spiral curves—the measurement and calculation of earthwork quantities.

Prerequisite: Course 3 of this department.

Time: Class-room, four hours a week, first semester.
Field, six hours a week, first semester.

8. Railway Location.

Under this head is studied the location of a railway under the three natural divisions of Reconnoissance, Preliminary Surveys, and Location Surveys, with the methods and instruments adapted to each. The theory of economy in grades and curves is considered at some length.

Prerequisite: Course 7 of this department.

Time: Class-room, five hours a week, second semester.

9. Contracts and Specifications.

Lectures on the laws governing contracts and their special applications to engineering construction; approved forms of specifications for various structures.

Time: Class-room, two hours a week, first semester.

Text: Wait, *Law of Contracts.*
Various standard specifications for reference.

10. Masonry Construction.

The lectures treat chiefly of the following subjects:

(1) Materials used in masonry construction, under the heads of stone, brick, lime, cements, wood, iron and steel. Special emphasis is placed upon the geological occurrences to the suitable materials and methods of testing.

(2) Foundations; open trenches, pile foundations, foundations under water, cofferdams, cribs, pneumatic and other methods.

(3) Dams; brush-cribs, framed timbers, masonry and rock fills.

(4) Retaining wall, bridge abutments and bridge piers.

(5) Culverts, wood, pipe and stone arches.

Prerequisite: Course 1 of Department II.
Time: Class-room, four hours a week, second semester.
Text: Baker, *Treatise on Masonry Construction.*

11. Sanitary Engineering.

An elementary course in sanitary science dealing with the drainage of building and lands, disposal of house-sewage, water carriage systems, storm sewers; also the heating, plumbing and ventilation of buildings both public and private.
Prerequisites: Course 1 of Department II, and Course 14 of Department I.
Time: Class-room, two hours a week, first semester.
Text: Merriman, *Sanitary Engineering.*

12. Sewerage and Drainage.

A study of the quantity of house-sewage and storm waters, the proper shape and dimensions of conduits for water carriage systems; sewer ventilation and flushing, office of man-holes, flush tanks and other details of construction; location of outfall, final disposal of sewage, sewage irrigation, filtration, septic treatment, cremation of refuse.
Prerequisite: Course 14 of Department I.
Time: Class-room, three hours a week, first semester.
Text: Folwell, *Sewerage.*

13. Water Supply.

The design, construction and maintenance of municipal water supply systems, under the following divisions: Sources and requisites of water supply, methods of collecting, storage and distributing water; the flow of water in various kinds of conduits, storage reservoirs, analysis and purification of public water supplies, pumping systems, maintenance of quantity and quality of supply, maintenance of storage and distribution works, house connections, meters and waste of water.
Prerequisite: Course 14 of Department I.
Time: Class-room, three hours a week, second semester.
Text: Folwell, *Water-Supply Engineering.*

14. Hydraulics.

Theoretical hydraulics, head and pressure velocity and path of a jet; instruments and measurements; practical formulae; flow of water through orifices, weirs, tubes, pipes and open channels;

losses of head, hydraulic gradient; nozzles, river-gauging, dynamic force of water; water-wheels, over-shot, breast and under-shot; turbines and impulse wheels; pumps, reciprocating and rotary, and pumping machinery.

Prerequisites: Course 1 of Department II, Course 12 of Department I, accompanying or preceding.

Time: Class-room, four hours a week, first semester.

Text: Merriman, *Treatise on Hydraulics.*

15. Geodetic Surveying.

A study of instruments and methods employed in geodetic surveying.

Prerequisites: Course 3 of this department.

Time: Class-room, two hours a week, first semester.

Text: Johnson, *Theory and Practice of Surveying.*

16. Roads and Pavements.

A brief discussion, from an engineering standpoint, of the principles involved in highway work under the following divisions: Economic importance and characteristics of good highways, location, construction, drainage, improvement and maintenance of country roads, various paving materials, broken stone, brick, asphalt, wood and stone blocks, and concrete, foundations for and adaptabilty of each, arrangement and details of city streets.

Prerequisite: Course 1 of Department II.

Time: Class-room, two hours a week, first semester.

Text: Spalding, *Roads and Pavements.*

17. Graphical Statics.

In this course the graphical methods of solving problems relating to forces in equilibrium are considered in detail. These methods are based upon the representation of forces in amount and direction by straight lines, the properties of force-polygons and equilibrium-polygons, moment and shear diagrams. Special attention is given to the application of these methods to the stresses in various framed structures.

Prerequisites: Course 1 of Department II.

Time: Class-room, one hour a week, second semester.
Laboratory, eight hours a week, second semester.

Text: Merriman and Jacoby, *Roofs and Bridges, Part II.*

18. Stresses in Frame Structures.

The application of the laws of forces in equilibrium to the computation of the stresses in various kinds of frame structures; the

method of moments; the method of resolution of forces; loads on a roof truss; dead, snow, and wind loads; changes in length due to changes in the temperature; highway bridges, dead loads, moving loads, snow and wind; applications of different forms of truss; railway bridges, dead loads, moving loads; snow, wind and impact; shear and bending moment; double and multiple truss systems; deflection of bridges. Numerous practical problems are presented for solution.

Prerequisite: Courses 11 and 12 of Department I.
Time: Class-room, four hours a week, second semester.
Text: Merriman and Jacoby, *Roofs and Bridges, Part I.*

19. Structural Details.

Practical applications of the principles of stresses in the design and proportioning of the various parts of engineering structures.

Prerequisites: Courses 17 and 18 of this department.
Time: Laboratory, six hours a week, one year.
Text: Merriman and Jacoby, *Roofs and Bridges, Parts III and IV.*

20. Concrete Structures.

This course deals with the designing and construction of reinforced concrete structures, the materials used and the methods employed; the properties of concrete and steel, practical formulas for the computation of all classes of structures, illustrations and descriptions of a large number of representative structures, properties and methods of testing the materials used, various types of reinforcement, forms, facing and finishing.

Prerequisites: Course 1 of Department II, and Course 10 of this department.
Time: Class-room, five hours a week, second semester.
Text: Buel and Hill, *Reinforced Concrete.*

21. Machine Design.

A study of the design of machine-elements and modern machines. Problems involving calculations of strength of various parts of machines and the adaptation of materials to the design are assigned. Lectures and recitations are carried on, Unwin's *Machine Design,* Part I, being used as a reference. In the draughting-room, the problems taken up in the lectures are made the subject of draughting-work.

Prerequisites: Course 1 of this department and Courses 11 and 12 of Department I, preceding or accompanying.

Time: Class-room, two hours a week, second semester.
Laboratory, four hours a week, second semester.

Text: Low and Bevis, *Manual of Machine Drawing and Design.*

VI. DEPARTMENT OF MINING GEOLOGY.

Arthur K. Adams, Professor.

This department aims to give its students knowledge concerning bodies of ore and their relations to geologic structure. It deals with that fundamental knowledge of minerals and conditions of ore deposition upon which the success of the operator so largely depends. It endeavors to give a training so that exploration and exploitation may be carried on, not only with accumulated knowledge, but also with more of the precision and certainty of scientific methods. In brief, its general aim is to promote an intelligent, systematic study of conditons, so that mining may become more and more a business and that the element of chance may be lessened.

1. General Geology.

All of the training in geology is arranged with special reference to professional work. There are three main classes of students to which the courses have been particularly adapted. The first class embraces those whose occupations are to be closely identified with mining. A second class includes those who look forward to employment of a more or less public character, such as is afforded by private, state and federal geological surveys. A third class aims to embrace students who expect to follow, in part at least, the pure science of geology, or to be connected with the economic and technical departments of higher educational institutions.

The instruction is conducted by means of lectures, recitations, laboratory examinations and frequent excursions into the field and is designed to familiarize the student with the data of geology. The processes and conditions of geology are considered in their different aspects. The laws and methods of interpretation of phenomena are discussed with considerable detail, training in the interpretation of geological phenomena being the object sought.

Features illustrating a large variety of geological phenomena are well displayed in the neighborhood of the School and afford excellent opportunites for field-work. The old Socorro volcano, rising 2,500 feet above the campus, presents many types of rocks, and many structures associated with volcanic districts. Lemitar mountain, ten miles away, affords other phenomena of vulcanism.

Faulting, folding, jointing and other associated features, are well displayed. The sedimentaries are well represented from the paleozoics to the most recent. The phenomena of erosion and the development of geographic forms are almost unique. With all these illustrations at the very door of the School, the student is never at a loss for something interesting and new.

Excursions are made, mines are visited and the student is instructed in the art of taking notes, and of making sketches and maps. He subsequently writes out a full but concise report of his observations, which is critically examined in all its aspects by the instructor in charge. These reports are then talked over in class, and the shortcomings noted and corrected.

Time: Class-room, two hours a week, one year.
Field, alternate Saturdays, 8:30—5:00.

Texts: Le Conte, *Text-Book of Geology.*
Geikie, *Text-Book of Geology.*
Geikie, *Structural and Field Geology.*
Chamberlin and Salisbury, *Geology.*

2. Mineralogy.

The first part of the course is devoted to a general study of crystallography, taking up the different crystal systems. This is followed by a study of the hardness, specific-gravity, cleavage, and other physical characteristics of minerals.

Blowpipe analysis is then taken up, observations being made in the laboratory of the behavior of minerals when heated in closed and open tubes and on charcoal. Sublimates characteristic of different elements are examined and recognized. Characteristic flame colorations are studied, and also colors imparted by oxides to microcosmic-salt and borax beads. A few wet tests for elements are also studied. The information thus acquired is then used in the Determinative Mineralogy which makes up the rest of the course.

Specimens of minerals from the large collections of the School and also those collected on field excursions or sent into the laboratory are examined and identified by the student, the crystal form, the physical and chemical properties and the paragenesis of each mineral being carefully studied. Special emphasis is given to acquiring familiarity with a large number of such mineral species as occur in mining regions and with the associations in which they are likely to be found. The order of study followed in the lectures is: The elements, sulphides, selenides, arsenides, tellurides, antimonides, sulphosalts, haloids, oxides, oxygen-salts, salts of the or-

ganic acids and hydrocarbons. Collateral reading is required on the important species.

Weekly quizzes, monthly reviews and other practical exercises supplement the daily lectures and serve to broaden the student's training, as well as to fix in his memory the various distinctions between mineral species. The relative values of each mineral, both from the standpoint of economic use and its worth for mineral collections, are clearly and fully set forth.

Prerequisites: Course 1 of this department and Course 2 of Department III.
Time: Class-room, three hours a week, second semester.
Laboratory, three hours a week, second semester.
Texts: Dana, *Text-Book of Mineralogy.*
Warren: *Notes on Blowpipe Analysis.*
Butler, *Handbook of Minerals.*

3. Historical Geology.

The development of the North American continent with special reference to the United States is taken up to show the past geologic and geographic conditions. It embraces the stratigraphy and the general geologic structure, showing the character of the sediments at different times. Fossils, the time-markers of rocks, are introduced wherever possible and the student becomes familiar with the conditions of deposition and the fossils characteristic of different periods.

Prerequisite: Course 1 of this department.
Time: Class-room, two hours a week, first semester.
Texts: Le Conte, *Text Book of Geology.*
Chamberlain and Salisbury, *Geology.*
Zittel-Eastman, *Paleontology.*

4. Geological Mapping.

Each student is assigned a limited area, often one square mile, and makes a topographic and geologic map of it, the method used being that of compass-traverses, and intersections. The map and report give detailed information as to the rocks; their character, attitude, relative age, and history. Contacts are traced out and plotted, the relation of the various rocks to each other being sought and the structure studied. The class-room work is devoted to discussion of questions arising in the field.

Prerequisites: Course 3 of Department V and Course 1 of this department.

Time: Class-room, one hour a week, first semester.
Field, alternate Saturdays, first semester.

5. Economic Geology, A.

This course embraces the study of ore deposits, first taking up the formation of open spaces, the filling of these spaces, the classification of veins and the theories of ore deposition. Different classifications of ore deposits are then discussed and examples given of each type of deposit, using Spurr as a text.

In the second half of the course, the iron ores are first considered, then those of copper, gold, silver and gold, silver and lead, lead, lead and zinc, zinc, etc., using Kemp as a text. The course includes lectures and much collateral reading.

Prerequisites: Courses 1, 2 and 3 of this department.
Time: Class-room, three hours a week, one year.
Texts: Kemp, *Ore Deposits in the United States and Canada.*
Spurr, *Geology Applied to Mining.*
Clarke, *The Data of Geochemistry.*
References: Posepny, *Genesis of Ore Deposits.*
Beck, *The Nature of Ore Deposits.*
Phillips, *A Treatise on Ore Deposits.*
Bulletins, monographs, folios, etc., of the United States Geological Survey.
Economic Geology and other mining magazines.

6. Economic Geology, B.

This course embraces the study of deposits of non-metallic minerals of economic importance, the geologic aspect being emphasized. The substances considered are coals, oils, gas, clays, cement rock, limestone, salt, gypsum, sulphur, fertilizers, abrasives, gems and minor minerals.

Prerequisites: Courses 1 and 2 of this department.
Time: Class-room two hours a week, second semester.
Text: Ries, *Economic Geology of the United States.*
References: Merrill, *Rock-forming Minerals.*
Crosby, *Chemical Geology.*
Mineral Industry of the United States.
U. S. G. S. Publications.

7. Lithology.

In the study of rocks, special emphasis is given to the texture and to the mineral compositon as determined by a hand lens and knife, with the purpose of acquiring the ability to make a classifi-

cation in the field. First, the igneous rocks are studied, then the sedimentary rocks and finally the metamorphic ones.

The study of Lithology should be taken up at the same time as Structural Geology as they can well be correlated.

Prerequisites: Courses 1 and 2 of this department.

Time: Class-room, two hours a week, first semester.
Laboratory, three hours a week, first semester.

Texts: Kemp, *Hand-Book of Rocks.*
Diller, *Educational Series of Rock Specimens.*

References: Geikie, *Text-Book of Geology.*
Chamberlain and Salisbury, *Geology.*
Geikie, *Structural and Field Geology.*

8. Structural and Dynamic Geology.

In this course, the major and minor structure of rocks are considered, hypotheses and theories being developed where possible, and the bearing on mining geology being constantly in mind. Among the subjects treated are: Classification of igneous rock masses by their shape, mechanics of igneous intrusion, joints, folds, faults, stratification, results of moving shoreline on sediments, formation of limestone, dolomitization, regional metamorphism, contact metamorphism.

Prerequisite: Course 1 of this department.

Time: Class-room, two hours a week, first semester.

Text: Geikie, *Structural and Field Geology.*

References: Geikie, *Text-Book of Geology.*
Chamberlain and Salisbury, *Geology.*
Van Hise, *Treatise on Metamorphism.*
Crosby, *Chemical Geology.*
Clarke, *Data of Geochemistry.*

9. Geological Surveying, A.

In this course, the students are divided into pairs, each pair working on an area of fifteen or twenty square miles. First, reconnaissance trips are made over the district and, later, detailed work is done and the contacts and relative ages of rocks determined. Each pair of students make a geologic map and report of their district, particular attention being given to problems of structure, ore deposits, etc. The Socorro sheet of the topographic maps issued by the United States Geological Survey is used as a base-map.

Prerequisites: Courses 1, 2 and 4 of this department.

Time: Class-room, one hour a week, first semester.
Field, every Saturday, first semester.

10. Geological Surveying, B.

This is more advanced than the preceding course and deals with problems in structural and dynamic geology, petrography, ore deposits, stratigraphy and correlation.

Prerequisite: Course 9 of this department.

Time: Class-room, two hours a week, one year.
Field, eight hours a week, one year.

11. Petrography.

At first enough optics is taken up to familiarize the student with the purpose, use and possibilities of a petrographic microscope. Different sections of minerals common in rocks are then studied and identified. This is followed by a detailed study of rock sections containing the minerals previously studied, the end sought being the identification of any rock by means of an examination of a thin section. The admirable collection of rock sections owned by the School is used throughout this course, and at the close each student makes and determines several sections from rocks collected during his field work.

Prerequisites: Course 7 of this department and Course 1 of Department II.

Time: Class-room, two hours a week, second semester.
Laboratory, three hours a week, second semester.

Texts: Rosenbusch-Iddings, *Microscopical Physiography of the Rock-Making Minerals.*
Adye, *Modern Lithology.*
Pirrson, *Rocks and Rock Minerals.*

12. Ore Deposits, A.

Theories of ore deposition are taken up in greater detail than in Course 6 and are subjected to more critical study and the role of igneous rocks in the formation of ore deposits is treated more elaborately than in the latter course. Conditions governing the formation of spaces, water circulation, precipitation and the filling of spaces, replacement, rock alteration and parageneses of minerals are taken up. The original literature is consulted wherever possible and much collateral reading is done.

Prerequisites: Courses 6, 8 and 9 of this department, and Courses 1, 2 and 3 of Department VII.

Time: Class-room, two hours a week, first semester.
Text: Posepny, *Genesis of Ore Deposits.*
Economic Geology.

13. Ore Deposits, B.

This is a continuation of course A and consists of the critical reading of other papers in Posepny's Genesis of Ore Deposits. In the second part, original literature concerning the newer mining camps is studied in an analytical way.

14. Paleontology.

A brief view of the fossils is taken with special reference to the geological succession in Southwestern United States. Characteristic types of each of the geological periods are studied with care. The methods of determining geological horizons by means of fossils are discussed and allusion made to geological correlations.
Prerequisites: Courses 1 and 3 of this department.
Time: Class-room, two hours a week, first semester.
Field and laboratory, three hours a week, first semester.
Text: Zittel-Eastman, *Paleontology.*

15. Abstracts.

Various articles in the current numbers of mining magazines are abstracted by the students and presented to the class.
Prerequisite: Course 5 of this department should accompany or precede.
Time: Class-room, one hour a week, first semester.

16. Special Problems.

It is expected that the student has already become more or less familiar with the various districts in the neighborhood of the School. He is encouraged to take up the exhaustive study of some limited area, in conjunction with, or under the guidance of his instructor, or he is given some area or theme that has already been well worked out and the results published, and he is required to repeat the investigation on his own account. There is a wide range of topics from which to select. Nearly all departments of geology offer problems that are both varied and highly instructive.

17. Valuation of Ore Deposits.

In this course special attention is given to methods of determining the shape, size, and richness of ore deposits; for, on these three factors depend the value of the mine, and the mining methods used in extracting the ore. In considering the dimensions of ore deposits, the general geological relations in the district are first

taken up, then the local geological structure is worked out in detail, especial attention being given to contacts, stratigraphy, faults, and joints as criteria for locating cut-off or "lost" ore bodies. Methods of estimating the amount of probable ore and possible ore in the mine, and the volume of dumps are also discussed. A great deal of importance is attached to sampling; methods of obtaining representative samples, frequency of samples, assay of samples, interpretation of assays, preparation and interpretion of assay maps in determining ore shoots, and methods of guarding against "salting" being discussed. The probable location, amount, and richness thus being determined, development work is put on a more scientific basis and mine valuation (the frequent duty of a mining engineer) is made more exact.

Prerequisites: Courses 5 and 9 of this department.

Time: Class-room, two hours a week, second semester.
Field, six hours a week, second semester.

18. Thesis.

Those students electing the curriculum in Mining Geology are expected to defend creditably the conclusions drawn from some more or less extended investigation. The theme may be in the nature of an extension of work already begun in the previous years, a special phase suggested during the preliminary researches, or on some entirely new subject selected by the candidate for a degree or by his instructor. Besides being distinctly a contribution to knowledge, the thesis must show ample evidence of a wide acquaintance with the literature directly bearing upon the theme.

It is expected that the student during the last term of his course will devote at least one-half of his time to the preparation of his thesis. The subject of the thesis must be announced before the Christmas recess, and that recess spent in doing part of the field work.

COAL MINING ENGINEERING.

As New Mexico contains about ten million acres of coal land, and as this coal land is beginning to be developed on a large scale, it has been thought advisable to offer some special courses in Coal Mining Engineering.

Five operating coal mines are within twenty-five miles of the School, and are open for inspection and study. Some of the model coal mines and coking plants of the country are located in the

northern part of the Territory and the Christmas vacation can be spent with an instructor inspecting these operations.

The Cerrillos Anthracite District is another profitable field for inspection trips.

If five students signify their intention of taking up Coal Mining, the following courses will be offered the first term: Geology of Coal, Coal Mining Methods, Coal Breaking and Coking. Prospective students in this work are requested to communicate with the School at their earliest convenience, giving a statement of their study, training, and experience in coal mining.

Geology of Coal.

In this course the origin of coal, the different kinds of coal, the structure of coal, its variations and irregularities, and the nature of the outcrop are considered. Features such as geologic structure and associated rocks common to all coal fields are then discussed, followed by a detailed study of the different coal fields, with a view of familiarizing the student with the geologic features of coal and the large features common to coal fields. Areal geological mapping of a coal mining region is also carried on with a view of determining the method of access to a certain coal seam (shaft, slope, or drift), and the best location for the mouth of the workings.

Coal Mining Methods.

The methods of breaking the coal dependent on its structure, attitude, and thickness are first taken up, followed by descriptions of the different systems of coal mining such as room and pillar, long wall advancing, long wall retreating, mining in benches, etc. The different systems of haulage; animal, endless rope, main-and-tail rope, compressed air, electric locomotives, etc., are taken up. The subject of ventilation receives considerable attention, as does the subject of mine explosions.

Coal Breaking and Coking.

Devices used in handling and breaking and sizing coal for market are first considered, followed by a discussion of machines used for washing coal. Then the study of coke manufacture is taken up; first the quality of coal suitable for coke, its preparation for the ovens, and then a critical study of the different kinds of coke ovens, methods of charging, time of burning, and method of drawing the coke. During the Christmas recess an inspection trip is made to the Raton Field where the different features of coal mining can be seen at their best.

VII. DEPARTMENT OF MINING ENGINEERING.

REINOLD V. SMITH, Professor.

The instruction in mining is given by means of lectures illustrated by photographs and detailed drawings. Recitations are held on assigned topics, and field examinations are made. The latter enter largely into the more practical part of the work. Mine administration and mining law receive detailed treatment. The entire course is pre-eminently practical in character.

As one of the chief purposes of the School is to prepare men to become designers of mining plants and supervisors of mining operations, the strictly business character of the profession is kept constantly before the student. Valueing property, properly reporting propositions submitted for investment, calculating in a careful manner the factors in the economical operation of a plant and suggesting the best methods of developing a property, are considerations which receive careful treatment and are given prominence during the latter part of the curriculum.

Especially are the similarities and departures between the operations and requirements of metal-mining and coal-mining brought out. Placer and hydraulic mining and dredging, and the recent adaptation of the steam shovel and stripping methods to western metal mines are treated at considerable length in the course on Mining Methods.

Another important feature which is continually being more and more considered in mining operations is the geology of the mineral deposits, and this subject receives greater attention than usual.

1. Mining, A.

The following subjects are studied:

Mineral deposits, their classification from a mining standpoint and their irregularities as affecting the work of exploration and mining.

Examination of mineral properties; relation of topography to geological structure; tracing of probable outcrops.

Prospecting by ditches, pits and deep borings.

Development; choice of methods; location of openings.

Excavation of earth; tools; methods; supports.

Excavation of rock; explosives, kinds, nature, manufacture and

use; methods of drilling and blasting, mammoth blasts, submarine blasting; quarrying.

Tunnelling: Methods of driving and timbering; submarine tunnels; permanent linings; sizes, speeds of advance and costs.

Boring: Methods and appliances for small depths and for deep boring; the diamond drill; survey of bore holes.

Shaft-sinking: Methods and tools for both hard and soft material; sinking; lining; handling and hoisting of material; timbering, walling and tubbing.

Surface workings and hydraulic mining.

Prerequisites: Courses 1, 2a and 3 of Department I; Courses 1 and 2 of Department II; Course 1 of Department III.

Time: Class-room, four hours a week, first semester.

Texts: Foster, *Ore and Stone Mining.*
Ihlseng, *Manual of Mining.*

2. Mining, B.

The subjects studied are:

Surface-handling and transportation; arrangements for loading, unloading and storage of minerals; mineral railroads and common roads.

Water supply.

Drainage: Sources, control and raising of mine waters; dams; drainage-levels.

Ventilation: Requirements for pure air; vitiation and purification of mine-air; methods of ventilation; measurement and control of air-currents.

Illumination: Candles; torches; lamps classified as oil, gasoline, magnesium, acetylene, electric and safety.

Accidents to men from fire-damp, dust explosions, mine-fires, falling material and inundations; prevention; rescue and relief.

Prerequisites: Same as for preceding course.

Time: Class-room, four hours a week, second semester.

Texts: Same as in Course 1.

3. Inspection of Mining Methods.

By inspection of mining methods followed in the various camps in the neighborhood of the School there is afforded great variety if illustration of the themes developed in the lectures.

The inspections are carried on partly as class-work in company with the instructor in charge, and partly as individual work. Full

notes are required to be taken and these are subsequently reduced in the office to proper form, accompanied by the necessary sketches and plans to make the whole procedure thoroughly intelligible.

Required as a two-weeks' trip to be made by all students of Mining Methods.

4. Ore Dressing.

An advanced course, the elements having been taken in General Metallurgy. In it is comprised a detailed study of severing by means of breakers, rolls, stamps and fine grinding machines; the sizing and classification of pulps by mechanical, pneumatic, and hydraulic processes; the principles and importance of sizing and classifying; the separation and concentration by hydraulic and electrical methods and also by means of oil and acid flotation.

Prerequisites: Courses 1 and 14 of Department I; Courses 1 and 2 of Department II.

Time: Class-room, four hours a week, first semester.

Text: Richards, *Ore Dressing and Concentration.*

5. Mine Plant.

The following machinery and appliances are studied and critically discussed.

Hoisting: Engines, drums, wire rope, skips and cages; head-frames; calculation of power required and methods of equalizing the load on the engine; devices for prevention of over-winding; shaft-sinking plant.

Drainage: Buckets, tanks and head-pumps; Cornish and direct-acting underground pumps; operation of pumps by electricity, compressed air and hydraulic power.

Ventilation: Natural ventilation, underground furnaces, positive blowers and centrifugal fans; efficiencies of fans.

Air-compressors: Straight-line and duplex; simple and compound compression; heat of compression; conveyance of compressed air; efficiencies.

Machine drills: Construction and operation.

Underground haulage: Mine cars; arrangement of tracks; hand tramming; mule and rope haulage; gravity roads; steam, compressed air and electric locomotives; comparative efficiencies.

Prerequisites: Courses 1, 2 and 3 of this department.

Time: Class-room, three hours a week, one year.

6. Power.

During the senior year a course of seventeen lectures will be

given with the object of reviewing the various modes of generating and distributing power for mining purposes. The limiting conditions, and economic aspects of power generation by various systems, and relative costs and efficiencies will be considered. Cost and other data of special installation will be given, and the conditions which operate to favor one system of transmission over another will be classified and compared.

Time: Class-room, one hour a week, second semester.

7. Design of Mine Plant.

The student applies himself to a given mine, makes the requisite surveys, plans the top-works, designs the requisite machinery for the specified duty, makes general drawings of the plant as a whole, and designs in detail and makes working drawings of those features of Hoisting, Haulage, or Drainage Plant, or Ore Handling Plant as may be assigned to him. On these portions he draws up specifications, bills of materials, and estimates of cost.

If an operating mine happens to be selected for this, the entire work is examined, improvements incorporated, and suggestions made as to possible savings. This work, when further elaborated, may be accepted as a thesis.

Time: Laboratory, three hours a week, one year.

8. Mine Constructions.

Under the head of Mine Constructions, the application of the principles of Civil Engineering to the structures most frequently required in mining is taken up. Mine buildings, bins, head-frames, trestles, crane-girders, fast-plants, tanks, etc., are studied as to form and materials of construction. The stresses produced in the members of these structures by the various kinds of loading, and the calculation of these stresses by algebraic and graphic methods are taken up.

In the laboratory the problems incident to design are solved and typical structures are designed and finished drawings made.

Time: Class-room, three hours a week, one year.
Laboratory, eight hours a week, first semester; six hours a week, second semester.

9. Mine Administration and Accounts.

In all the mining courses, particular stress is laid on the business aspects of mining operations. The value of keeping tabulated record of different grades of work and its cost from day to

day is urged as a means of constantly reducing the fixed charges and of doing away with much of the extraordinary expenditures without reducing the efficiency of the work. The devising of methods of increasing the output with limited working forces is emphasized.

The subject of labor in its various phases, the details of supplies, and the sale of ore prepared for market are taken up, and mine accounts, statements of cost, and monthly reports are discussed.

Time: Class-room, two hours a week, first semester.

10. Mining Law.

A short course of lectures on mining law (particularly in relation to the manner of locating placer, lode, and tunnel claims), on water rights, law of the apex and similar questions is given by legal practitioners at intervals during each year. All students are expected to attend.

11. Examination of Mines.

The main object sought in this course is to train the student sufficiently in expert mine examination work to enable him to report intelligently upon a mining proposition as to the advisability of purchase or of operation.

Practice is afforded in making regular reports, complete in every respect, on different kinds of mining properties. Each student is assigned a different mine or property to examine. In case the mine has been reported upon in previous years, detailed comparison of the results is afterwards made.

Among the more important topics usually considered are the topography of the district as an index to its accessibility, outside constructions, the character of the geological formations, the geological structure (particularly as affecting the ore bodies), the character and disposition of the ores, the amount of ore developed, the probable extent of the unexplored part of the deposit, the best method of extracting the ore, of concentrating it, of preparing it for shipment or treating it immediately for the metal, the water facilities and the facilities for transportation to market. Full computations are required, including estimates of the cost of each process, of the necessary plant, and of each of the various parts.

Time: Class-room, one hour a week, second semester.
Field, six hours a week, second semester.

VIII. DEPARTMENT OF METALLURGICAL ENGINEERING.

REINOLD V. SMITH, Professor.

The Metallurgical Department aims to turn out its graduates equipped with the knowledge necessary to the successful management of metallurgical plants, and to take full charge of metallurgical operations. The graduate from this department has acquired a good working knowledge of assaying, chemistry, mill-work and smelting processes.

The courses have been chosen with special reference to giving to the student in metallurgical engineering a general knowledge of modern metallurgy as a whole, and special knowledge of the metallurgy of each of the more important metals. This special knowledge is attained by lectures, readings, discussions, laboratory work and inspection of metallurgical plants.

1. Fire Assaying.

The instruction in assaying is given by means of lectures and laboratory experimentation, the practice in the laboratory illustrating the lecture-courses. The laboratory is well equipped with several different types of assay-furnaces for crucible work, scorification, and cupellation, and with everything that goes to make up a well furnished assay-office.

This course comprises fusion methods for gold, silver and lead: The crucible-assay of oxidized ores for gold and silver in the muffle and in the pot-furnace; crucible assay of sulphide ores for gold and silver by the iron, roasting, and preliminary fusion methods; also the crucible assay of lead ores. The scorification-assay of mattes and speisses, with preliminary wet treatment; assay of litharge and lead. In the assay of base-bullion, silver-bullion and gold-bullion, the methods in use in the United States mints are followed. Sampling and the preparation of the sample for assay; making cupels, and the management of the assay office and the special duties of practical assayers are considered.

Numerous samples are provided, all of which have been previously accurately assayed at the College, at the smelter whence they came, or at the mint. The student works upon these until he attains a high degree of proficiency. No student is allowed to pass this subject until he has become an experienced assayer.

Prerequisites: Courses 1, 2 and 3 of Department III, and Course 2 of Department VI.
Time: Class-room, one hour a week, second semester.
Laboratory, eight hours a week, second semester.
Texts: Lodge, *Notes on Assaying.*
Furman, *Manual of Practical Assaying.*

2. General Metallurgy.

A study of the physical and chemical properties of ores and metals as determinants in extraction-methods; furnaces, their classification and structure; fuels and thermal measurements; characteristic metallurgical processes; materials and products of metallurgical processes; alloys; thermal treatment of metals preparatory to their use.

The most recent practical processes will be also presented and local metallurgical processes will be considered.

The course is to be supplemented by visits to neighboring plants and, at the end of the school-year, by vacation trips of metallurgical inspection.

Prerequisites: Course 1 of Department III; Course 1 of Department II, and Course 2 of Department VI must precede or accompany.
Time: Three hours a week, second semester.
Texts: Roberts-Austen, *Introduction to the Study of Metallurgy.*
International Library of Technology, *Gold, Silver, Lead and Zinc.*

3. Furnaces.

This course is given by way of an extension of the topic "furnaces" as treated in General Metallurgy. It is concerned with the theories of high temperature generation, heat conservation measurement and control; and with the design of furnaces for various industrial purposes and for stated capacities; and with the erection and control of smelting furnaces in particular.

Time: Class-room, three hours a week, first semester.
Text: Demaur, *Industrial Furnaces.*

4. Metallurgy of Lead.

An advanced course in lead-metallurgy; occurrence of lead; the lead reverberatory furnace; Corinthian, Silesian and English methods of treating lead ores in the reverberatory furnace; Scotch,

American and Moffet types of ore hearth; smelting lead ores in the ore-hearth; roasting-furnaces for lead ores; roasting galena as a preliminary to blast-furnace treatment; the lead blast-furnace; calculation of blast-furnace charges; details of running a lead blast-furnace; desilverization of base bullion.

Prerequisite: Course 2 of this department.
Time: Class-room, three hours a week, first semester.
Text: Hoffman, *Metallurgy of Lead.*

5. Metallurgy of Copper.

Occurrence of copper; roasting copper ores in heaps, stalls and roasting furnaces; blast-furnace smelting; pyritic smelting; reverberatory smelting; bessemerizing copper mattes; electrolytic refining of copper; selection of process and management of plant.

Prerequisite: Course 2 of this department.
Time: Class-room, two hours a week, first semester.
Text: Peters, *Principles of Copper Smelting.*

6. Metallurgy of Gold and Silver.

Occurrence of gold and silver; placer mining; the patio process; crushing and amalgamating machinery; pan amalgamation; chlorination by the vat and barrel processes; cyaniding by the MacArthur-Forest and Siemens-Halske processes; modern methods of cyanide treatment of slimes by pressure and vacuum filters; lixiviation of silver ores; pyritic smelting; refining and parting of gold bullion.

Prerequisite: Course 2 of this department.
Time: Class-room, five hours a week, second semester.
Texts: Rose, *Gold.*
Collins, *Metallurgy of Silver.*

7. Metallurgy of Iron.

Modern methods of the production of pig iron, wrought iron and steel; the iron blast-furnaces; white cast-iron; gray cast-iron and spieged-iron; puddling; wrought-iron; the Bessemer and Siemens-Martin processes; steel.

Prerequisite: Course 2 of this department.
Time: Class-room, four hours a week, second semester.
Text: Howe, *Metallurgy of Steel.*

8. Metallurgical Inspection.

Visits of inspection to mills and reduction-works. While these visits are required during the third year only, at which time the student is capable of understanding all he sees and thus deriving

the maximum amount of benefit from it, students not so far advanced are advised to take these trips whenever it does not seriously conflict with other studies.

A visit may be extended by special permission and the mill or reduction-works used to furnish the material for a thesis.

9. Metallurgical Plant and Design.

Some time during the latter part of the general course in metallurgical engineering, the student devotes a part of his time to detailed and original plans for a plant for ore treatment. From year to year, the condiitons vary so that no two persons have the same work. The designs are based upon the surveys made by the student upon sites especially selected for peculiar conditions presented. The working plans for the buildings, concentrators, furnaces, etc., are drawn up complete in every respect, the full bill of materials made out and the cost of the several parts and of the whole carefully estimated according to the trade conditions and labor factors existing at the time. In fine, the entire work and all computations are carried out according to the best engineering practice, and with the same care that actual construction operations require.

Prerequisites: Courses 11, 12, 13 and 14 of Department I; Course 21 of Department V; Course 6 of Department VI, and Course 2 of this department.

Time: Class-room, one hour a week, first semester.
Laboratory, three hours a week, first semester, and six hours a week, second semester.

10. Thesis.

Each student, before receiving the degree of Metallurgical Engineer, is required to prepare and to present to the Faculty an important scientific treatise upon a metallurgical subject. This treatise must be based upon work carried out by the writer. It must contain a complete record of all work performed by the writer upon the subject treated, the conclusions drawn from the work, and a statement of the lines along which, in the writer's opinion, it would be advisable to pursue the investigation further.

BUILDINGS AND GROUNDS.

The Campus.

The School of Mines campus is situated on the northwest edge of Socorro. It contains 20 acres of nearly level ground within the irrigable belt. Groves of trees have been planted; and trees line the walks and drives.

Main Building.

The main building consists of three stories and a high basement. It is T-shaped, 135 feet long by 100 feet, the central rear wing being 54x32 feet. It is constructed in a very substantial manner of a beautiful gray granite, in broken ashler, trimmed with Arizona red sandstone.

The building is handsomely finished throughout in oiled hard woods. It is well ventilated and has all modern conveniences, being piped for water and gas and heated by a good hot-water system. Electric lights for illumination and for experimental purposes have just been put in.

As now arranged, the main floor of this building contains the president's office, the general library, the chemical laboratory, instructor's office, assay-laboratory, balance-rooms, and lecture-room. The basement contains the mineralogical museum, lecture-room, chemical supply-room, boiler-room, engine-room, lavatories, and general storage-rooms. A lecture-room occupies most of the secod story. The third story includes a lecture-room, supply-room, photographic dark-room, and storage closets.

Engineering Hall.

The south wing of this building has already been erected. It is built of Socorro cream brick with gray trachyte trimmings.

As planned for completion, the building is to be X-shaped, the central pavilion two stories and the four wings one story. With its spacious rooms, it will be peculiarly adapted to engineering instruction.

When the building is completed, the entire north wing will be devoted to draughting purposes, the light coming from above. At present, the main draughting-room is in the south wing which also is a lecture room. Off this are the instructor's office, and a blueprint room. A photographic room is fitted up in the main building.

Dormitory.

The Thirty-seventh General Assembly in 1907 appropriated \$15,000 for the erection and furnishing of a students' dormitory at the School of Mines. The building was erected in the summer and fall of 1908 and was opened for occupancy January first of the present year. It is admirably suited to its purpose.

The dormitory is a substantial brick structure containing two stories and a basement. It is heated throughout with hot water and lighted with electricity. In the basement are the heating plant and a well equipped shower bath. On the first floor are the dining room, commodious, well furnished, and pleasant, the kitchen, the reception room, the matron's rooms, servants' rooms, a bath room, and a large study and assembly room for the use of the academic department. The students' rooms are on the second floor. They are large, well lighted and heated, and comfortable in every respect. Each is equipped with a lavatory supplied with hot and cold water, two single bedsteads together with mattresses and pillows, three chairs, a study table, and a bureau. Each room has, also, a large closet adjoining. There is a bath room on this floor. The hallways are broad and well lighted and the building is finished throughout in hard pine shellacked so as to leave its natural color. The general effect is altogether pleasing.

It has already been demonstrated that students can be accommodated with board and lodging at the dormitory at the rate of \$20 a month, they being required to furnish only their own bed covering. This rate is fixed for cases in which two students occupy the same room. Five dollars a month additional is charged a student who wishes a room by himself. These fees are required to be paid monthly in advance. A deposit of five dollars is required, also, of each student in the dormitory to cover the cost of possible breakage or damage to his room or its furniture. After paying the cost of such damage or breakage, if any, the balance of this fee is returned to the student at the end of the year.

Rooms in the dormitory are assigned to students in the order of application.

EQUIPMENT.

Chemical Laboratory.

The chemical laboratory of the New Mexico School of Mines is very complete in its equipment, everything being provided for the needs of the students in their various courses. The laboratory is equipped with desks, one of which is assigned to each student. Each desk is six by two and one-half feet and thirty-eight inches high and has a cupboard on one side and a tier of five drawers on the other, all under Yale locks. There are water and gas connections, sink, and shelves for reagents with each desk. Every student in chemistry is supplied with a complete set of reagents and all apparatus for the work to be undertaken. For general use, are provided evaporation-hoods, special tables and a balance-room containing quantitative balances of Becker's construction.

The chemical lecture-room is provided with standard lecture-room chairs, especially adapted to the convenience of students in taking notes. The lecture-table, extending across one end of the room, is fitted with water and gas-connections and large sink.

Assay Laboratory.

The assay laboratory occupies the main floor and basement of the west wing of the main building. The furnaces are all new and include muffle gasoline blow-pipe furnaces of different types, and large muffle-coke furnaces. This department is conveniently arranged with shelving, drawers and boxing for fluxes and other assaying materials and supplies.

A weighing-room, containing a number of Becker's balances, is conveniently located between the furnace-room and the lecture-room. In the grinding-room, which is in the basement, is an eight horse-power gasoline engine of Weber type, which runs the Dodge ore-crusher, a Bolthoff sample-grinder, and will supply power through a line of shafting to other machines. There are also a Bosworth laboratory crusher, bucking-board, mullers and other necessary apparatus.

Physical Laboratory.

The physical laboratory, on the third floor of the main building, contains the usual apparatus for illustrating the facts and laws of physics. In addition, there has just been added, at a considerable

expense, all the apparatus necessary to perform the quantitative experiments outlined in Course 1 of Department II.

Petrographical Laboratory.

For the microscopic study of rocks, both in elementary and advanced or graduate work, the School is well supplied with microscopes and other necessary apparatus. There has recently been added to the equipment a new style large microscope, manufactured especially for this institution by Reichert, of Vienna. It is constructed especially for obtaining fine results in microphotographic work. The stand includes a Continental Model sub-stage with rack and pinion, an Abbe sub-stage condenser, with iris diaphragm, plane and concave universal mirror, triple nose-piece, and a full set of objectives and eye-pieces. Among the accessories are a micrometer eye-piece, compensating eye-piece, polarizing apparatus, stage micrometer, drawing apparatus, quartz-wedge, quarter-undulating micaplate, and other necessary pieces.

A rock-slicing machine with power attachments enables the student to prepare thin sections of the rocks which he is studying.

Among the series of thin-slices of rocks, are a collection of types of the massive crystallines of Europe, prepared by Krantz of Bonn, and completely illustrating Zirkel, sets of Maryland massives, and other American rocks and minerals. The Sturtz collection of European rocks illustrating Rosenbush and large miscellaneous collections are expected to be soon available for study.

Engineering Department.

For land, railroad and mine-surveying the department has full sets of instruments, including transits, levels, poles, leveling-rods, chains, pins, steel-tapes, hand-levels, compasses and clinometers.

The department has lately added to its equipment a fine large engineer's transit and all accessories, manufactured expressly for this institution, after improved designs by the Gurleys of Troy. There is included an extension tripod, auxiliary telescope, reflector, gradienter attachment, diagonal prism and solar apparatus.

Draughting Rooms.

A spacious, well-lighted draughting-room is provided in the engineering building. Opening off from it are the instructor's office, supply-room, blue-print room with large printing frame on steel track, developing-vat and drying-rack.

A drawing table is furnished each student. There are private

spaces for his materials and instruments. Provision is also made for models and illustrative materials.

The photographic room is located in the main building.

Mineralogical Museum.

The School owns a very fine collection of minerals of all kinds. These, properly labeled and arranged in glass cases, are housed in the north wing of the main building.

The major part of the New Mexico mineral exhibit at the Louisiana Purchase Exposition at St. Louis consisted of the collections prepared by the School of Mines. The display occupied a prominent place near the center of the Palace of Mines and Metallurgy. As the only exhibit of the kind made by a mining school, it attracted wide attention.

The display was planned to center around a large colored relief-model of New Mexico on a scale of half an inch to the mile—or nearly 20 feet square. On this model was shown all the mineral resources. It was accompanied by a large colored section of the geological formations.

Arranged in a score or more of large glass cases, were the leading mineral products of New Mexico, selected with special care as to value and beauty. Included, were a number of cases of remarkably rare and showy zinc and copper minerals and ores. A special series consisted of zinc carbonate minerals which, for variety, delicacy of coloration and beauty have never been surpassed. Two immense pyramids of showy crystalline ores were embraced in the display.

Four large special collections were of particular interest. These consisted of (1) the largest variety of zinc and copper minerals and ores from a single locality; (2) a collection of rare zinc and copper ores; (3) a unique collection of showy crystals of zinc and copper minerals; and (4) a complete smelting proposition from a single mine.

For these displays and several others, gold and silver medals were awarded.

All the collections have been returned to Socorro and now form a prominent feature in the museum of the School of Mines.

LIBRARIES.

The libraries of the New Mexico School of Mines consist of a general library and department libraries.

In the main library are the works of reference, the encyclopedias, dictionaries, journals, magazines, proceedings of the learned societies, perodical issues of other colleges, reports of federal, state and foreign surveys, official maps, plats and atlases, and volumes on history, travel and philosophy.

The following perodicals are received by the School:

Engineering and Mining Journal.

Mining and Scientific Press.

Engineering Record.

Power.

Engineering News.

Mining Science.

Mines and Mining.

Mines and Minerals.

Engineering Magazine.

American Chemical Journal.

Review of Reviews.

Economic Geology.

School of Mines Quarterly.

New Mexico Journal of Education.

All the U. S. G. S. Publications.

Libraries are located in the several departments of the School. These are essentially working libraries. They consist of carefully chosen treatises, text-books, monographs, special contributions, and authors' separates, pertaining to the respective divisions.

Powell Library.—The School has come into possession of the private library of the late Major John W. Powell, of Washington, D. C., who for many years was director of the United States Geological Survey. The collection embraces several thousand titles. The volumes are chiefly works on mining, geology and philosophy, many of which are rare, and all are of great practical value. Especially well represented is the literature relating to the Rocky Mountain region and the great Southwest. It was in these fields that Major Powell did most of his work, which has had such an important influence on the development of the mining industry. It therefore seems particularly fitting that the library of this famous man, who had been so long identified with this western country, should find a permanent home in New Mexico.

THE TORRANCE MINE.

The School of Mines has become the owner of the Torrance Gold and Silver Mine at the base of the Socorro Mountain, only about two miles from the School campus. This mine affords excellent opportunities for the practice of mine-surveying and for a study of all the various features of practical mining. Here are to be studied a double-compartment incline shaft, a fine example of mine-timbering, various levels, cross-cuts, winzes, shafts, stopes, ore-bodies with associated geological structures and many other features of interest to the student of mining engineering.

INSPECTION VISITS.

Students in the mining and metallurgical courses are expected to make a two weeks' tour of inspection of the mines, concentrators and smelters lying within easy reach of Socorro under the direction of the professor of mining and metallurgy. This tour may be made either during the Christmas vacation or at the close of the school year. Special stress is laid upon the proper keeping of notes. These are fully written up each day and are made use of later as a basis of other work in connection with the regular courses. If carefully kept, they prove valuable references in later years.

Inspection visits have been made to the mines, concentrators and reduction works at El Paso, Douglas, Bisbee, Tombstone and Cananea.

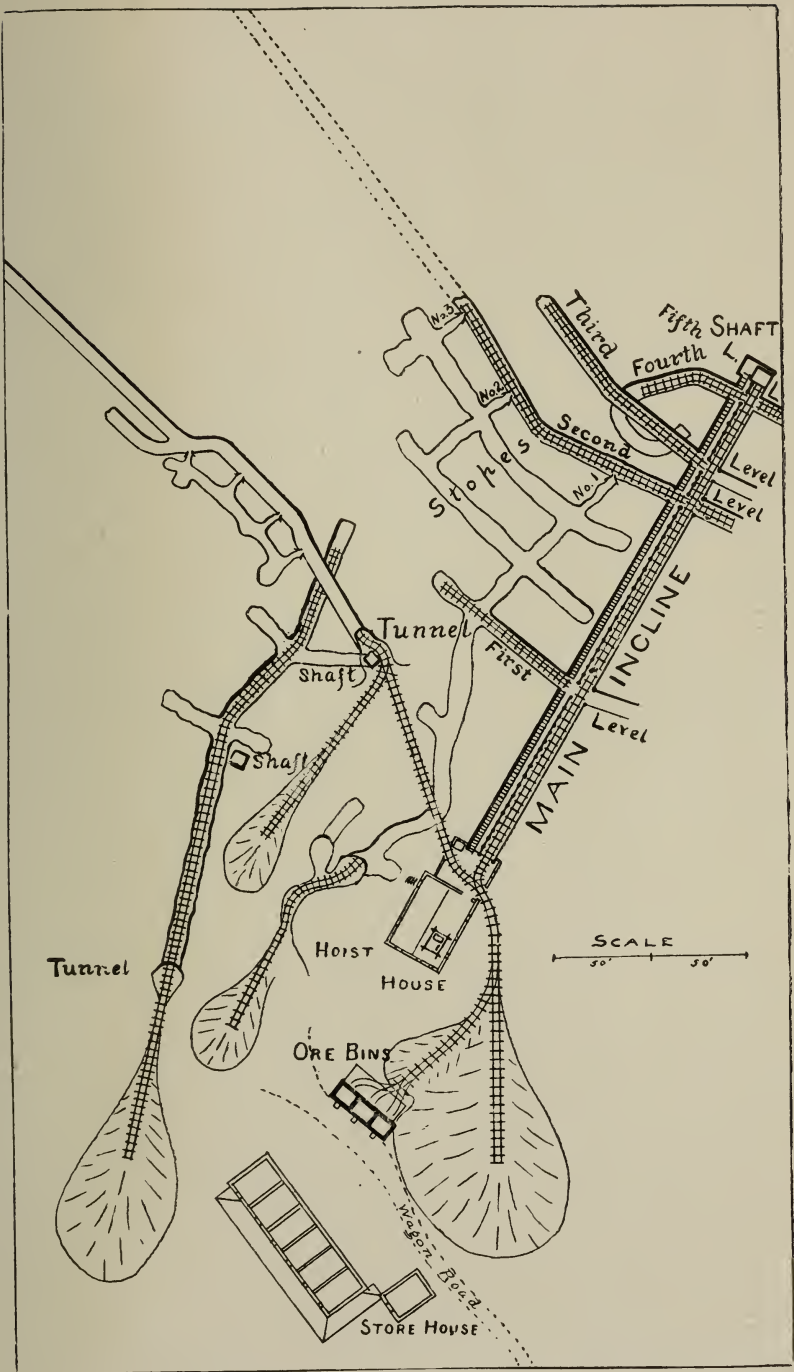
EXPENSES.

Matriculation Fee.

A matriculation fee of five dollars is required of each student before beginning work in the School for the first time and, of course, is paid only once.

Tuition Fee.

The fee for tuition is twenty-five dollars a semester except to citizens of New Mexico, the tuition fee for the latter being ten dollars a semester. This is payable at registration and its payment, after matriculation, admits the student to all class-room instruction.



PLAN OF THE TORRANCE MINE.

Laboratory Fees.

The laboratory fees are intended to cover the cost of gas, water and materials for which the student does not pay directly and to compensate for the depreciation, due to use, in the value of the apparatus. These fees are payable at the time of registration and are as follows: General Chemistry, Qualitative Analysis, Quantitative Analysis, Water and Fuel Analysis, Wet Assaying, each $5.00; Fire Assaying, $10.00; Mineralogy (Blowpipe Analysis), $3.00.

A deposit of $3.00 is required from each student who registers for any one of the foregoing courses. This deposit will be returned to the student after deducting any amount which may be due for the breakage of apparatus.

Graduation Fee.

The graduation fee, payable before delivery of diploma, is as follows:

Mining, Metallurgical, or Civil Engineer	$10.00
Bachelor of Science	5.00

Board and Rooms.

Rooms may be obtained at a cost varying from $6.00 to $8.00 a month; board, at the hotels and best boarding-houses, for $5.00 a week. The cost of living at the dormitory is $20 a month.

BOOKS.

Books are furnished to the students at cost.

SCHOLARSHIPS AND PRIZES.

Scholarships.

Through the generosity of the members of the Board of Trustees, of the Thirty-seventh General Assembly of New Mexico, and of the Allis-Chalmers Company, the New Mexico School of Mines has been able to establish a system of scholarships. These scholarships are awarded annually as honors, the main object being to encourage earnest effort on the part of those who wish to prosecute studies related to mining in this institution.

School of Mines State-Scholarships.—To one student from each state of the Union, is open a scholarship yielding free tuition. Each scholarship may be held for one year and is assigned to that applicant who shows the greatest proficiency in subjects already pursued by him. Application must be made in writing to the President and, in the case of those who have not been students in the School, must be accompanied by a certified statement of subjects pursued and the grades received therein, unless the applicant prefers to pass an examination in the subjects for which he seeks credit.

School of Mines County-Scholarships.—Scholarships are open to two students from each county in New Mexico. These scholarships yield free tuition and are subject to the same conditions as the State-Scholarships.

New Mexico Scholarships.—The Thirty-seventh General Assembly of New Mexico gave to each representative, to each councilman and to each board of county commissioners the privilege of appointing a student to a scholarship in any one of the educational institutions of the Territory and provided an appropriation of $200.00 for each appointee.

Allis-Chalmers Scholarship.—To one member of each year's graduating class, there is offered by the Allis-Chalmers Company, manufacturers of mining and heavy machinery, with large works at Chicago, Milwaukee, and Scranton, an opportunity for four months' study and employment in any of its plants, and an emolument of $150.00.

This scholarship is awarded by the Board of Trustees on the recommendation of the Faculty from those graduates of the year filing application before the 10th of June. The opportunity is an

exceptional one to observe and study the building of all kinds of modern mining and metallurgical constructions.

Prizes.

The Brown Medal.—Hon. C. T. Brown, of Socorro, offers annually a gold medal to the student who, while doing a full year's work, has shown the greatest proficiency in the courses in Wet Assaying and Fire Assaying. The medal is awarded each year at commencement. Only those students are eligible as contestants for the medal who, at commencement, are found to have completed the courses named and, of course, the prerequisites to these courses.

SUMMER WORK.

The proximity of the School to mineral properties, mines and smelters makes it easy for the student to secure employment during the summer (and during the Christmas vacation, if desired) and, at the same time, to acquire much practical experience in the line of his profession. That this advantage has been appreciated is shown by the large proportion of students who yearly make use of this opportunity. During the past years, land-surveying, mine-surveying, geological surveying, assaying and mining have been attractive fields of work for the students during the vacations.

DEGREES.

The degree of Bachelor of Science, Mining Engineer and Civil Engineer are conferred by the Board of Trustees upon recommendation of the Faculty.

The candidate for a degree must announce his candidacy at the beginning of the school year at whose termination he expects to receive the degree. This announcement must be in writing and must specify both the curriculum and the degree sought.

The degree of Bachelor of Science is conferred upon those who, as students of this institution, have completed the prescribed collegiate courses of any one of the several curricula. This degree is also conferred upon those who, as students of this institution, have completed the courses which represent one full year's work in any one of the several curricula and have given satisfactory evidence

of having previously completed the other courses of that curriculum.

The degree of Mining Engineer is conferred upon each one who, as a student of this institution, has completed the prescribed courses of the four-year curriculum in Mining Engineering, Metallurgical Engineering or Mining Geology, has presented an original and satisfactory dissertation in the line of his work, and has done two years of professional work, of which one must be in a position of responsibilty. The degree is also conferred upon each one who, as a student of this institution, has completed the courses which represent one full year's work in one of the four-year curricula just named, has given satisfactory evidence of having previously completed the other courses of that curriculum and has complied with the specified conditions concerning a dissertation and professional work.

The degree of Civil Engineer is offered upon terms similar to those required in the case of the mining engineer, except that the candidate substitutes, in some of his later work, courses which relate more directly to the profession he expects subsequently to follow.

Work done at other colleges by candidates for a degree may be accepted so far as it corresponds to the work done here, but, in each case, the Faculty reserves the right to deside whether the previous work has been satisfactory.

It is expected that the thesis in each case shall be prepared with sufficient care and exhibit sufficient intrinsic evidences of independent investigation to warrant its publication, in whole or in part.

COMMERCIAL ANALYSES.

The wide demand which exists in the great mining district of the Southwest for disinterested and scientific tests and practical investigations has lead to the establishment, by the New Mexico School of Mines, of a bureau for conducting commercial work relating to mining and metallurgy.

The performance of such work is made possible, and accurate results assured, by reason of the exceptional facilities of the laboratories of the school and the extensive practical experience of the instructors. The rapidly increasing amount of this work intrusted to the school is sufficient evidence in itself that the plan has been long needed to further the development of the mineral resources of the region.

A special act of the Legislature makes provision for carrying on commercial testing. The section from the law governing the School of Mines, Chapter 138, Section 38, Acts of 1889, reads: "The Board of Trustees shall require such compensation for all assays, analyses, mill-tests or other services performed by said institution as it may deem reasonable, and the same shall be collected and paid into the treasury of the School of Mines.

A special circular is issued, giving the schedule of charges, other necessary information and methods of preparing and shipping samples. Copies are mailed on application. By special resolution, it is required that all charges shall be paid in advance.

Commercial Assaying.—The assaying for gold, silver, copper, lead, zinc and the common metals, is carried on in all its various phases. All work is run in duplicate and, in case of any non-concordant results, such assay is repeated. Particular attention is paid to umpire work.

Determinations of silica, iron, alumina, magnesia and manganese and the rarer metals such as uranium, vanadium, nickel and cobalt are made according to the best methods.

Water Analysis.—The chemical analysis of waters for city-water supplies, boilers and domestic use, and of mineral and mine-waters has, of late, assumed great importance. The chemical laboratory of the School is fully equipped for this work and, in the case of bad waters, remedies and methods to be used to improve the waters for specific purposes are suggested. A large number of analyses of waters from the Southwest have already been made, and very interesting results obtained.

Fuel Analysis.—Another branch of work which has been constantly receiving more attention has been an inquiry into the fuel values of the coals of the region. Complete analyses and heat tests have been made of some of the principal deposits. With the work already done, the results of new analyses are made of special value on account of the comparative figures that can be supplied.

DIRECTORY OF GRADUATES AND FORMER STUDENTS.†

ARTHUR H. ABERNATHY. Chamberino, New Mexico.

Student 1898-1901. From Pinos, Zacatecas, Mexico Assayer, Cananea Smelting Works, 1901.

C. E. BARCLAY. Maria, Texas.

(A. B., University of Virginia.)
Student, 1896-97. From Bowlng Green, Kentucky.

JAMES F. BERRY. Zacualpan, Mexico.

Student 1904-5. From Socorro, N. M. Assayer with American Smelting and Refining Company, at Aguas Calientes, 1905; Assayer City of Mexico, 1906-7; Chemist, Cia Metalurgica y Refinadora del Pecifico, Fundicion, Sonora, Mexico, 1907-8.

LOUIS AUGUST BERTRAND. Upland, Nebraska.

Student, 1895-6. From Conway, Iowa. Student Ecole Professionella de l'East, Nancy, Lorraine, 1890-95; Instructor in Mathematics and French, New Mexico School of Mines, 1895-6; Chemist, El Paso Smelting Works, El Paso, Texas; Assayer and Surveyor, Consolidated Kansas City Smelting and Refining Company, Chihuahua, Mexico; Superintendent, Carmen Mines, Coahuila, Mexico; Superintendent, Compania Mineros de Penales, Mapimi, Durango, Mexico, 1901.

CHAUNCEY E. BUTLER.* Dedrich, California.

Student, 1893-6. From Kelly, New Mexico. Assayer, Cibolo Creek Mill and Mining Company, San Francisco, California, 1896; Assayer and Furnace Superintendent, La Compania Minera Lustre, Magistral, Estado de Durango, Mexico, 1897-98; Chemist and Assayer, United Verde Copper Company, Jerome, Arizona, 1898-1903; Superintendent, Trinity County Gold Mining Company, and Jenny Lind and Maple Mining Company, Dedrich, California, 1903.

R. HARLAND CASE. Colorado Springs, Colorado.

Student, 1902-5. From Cerrillos, N. M. Chemist, Compania Metalurgica de Torreon, Torreon, Mexico, 1905-6; Assistant Superintendent, Bonanza Mine, Zacatecas, Mexico, 1906; Assistant-Manager, Stephenson-Bennett Mining and Milling Company, Organ, New Mexico, 1906-7; Consulting Engineer, Western Mining, Milling and Leasing Company, Colorado Springs, Colorado, 1907-8.

EDWARD C. CHAMNEY. Minnehaha, Arizona.

Student, 1899-1900. From Shipley, Ontario, Canada. Assistant in

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† Information concerning former students not here listed or concerning changes of address of those already listed will be gladly received.

* Deceased.

General Science, New Mexico School of Mines, 1900-1; Assayer, Oro Mining Company, Minnehaha, Arizona, 1901.

VIVIAN V. CLARK. Reiter, Washington.

Student, 1896-8. From Kelly, New Mexico. Assayer, Bland Milling Company, Bland, New Mexico, 1898-9; Superintendent, Navajo Gold Mining Company, Bland, New Mexico, 1900; Manager, Higueras Gold Mining Company, Sinaloa, Mexico, 1901; Mine Operator, Albuquerque, New Mexico, 1902; Manager, Bunker Hill Mining and Smelting Company, Reiter, Washington, 1903; Consulting Engineer, Consolidated Exploration Mines Company, New York, and allied syndicates, 1909.

DAVID JOSHUE CLOYD. Torreon, Coah, Mexico.

Student, 1899-1900. From Decatur, Illinois. Chemist and Assayer, Wardman's Assay Office, Aguas Calientes, Mexico, 1900-1906; Assistant Superintendent, Cia Minera del Tiro General, Charcas, S. L. P. and Assistant Superintendent, Cia del Ferrocarril Central de Potosi, Charcas, S. L. P., 1906-8; Assayer and Chemist, Dailey, Wisner & Company, Torreon, Coah., Mexico, 1908.

SAMUEL COCKERILL. Milwaukee, Wisconsin.

(B. S., New Mexico School of Mines, 1906.)

Student, 1904-5. From North Fork, Virginia. Post-Graduate Engineering Course, Allis-Chalmers Company, 1906-8; Milwaukee Coke and Gas Company, 1908.

LEON DOMINIAN. Mexico City, Mexico.

(B. A., Roberts College, Constantinople, 1898; C. I. M. Mining School, University of Liege, 1900.)

Graduate Student, 1903-4. From Constantinople, Turkey. Assistant, U. S. Geological Survey, 1903; Instructor in Mathematics, New Mexico School of Mines, 1903-4; Engineer to Victor Fuel and Iron Company, Denver, Colorado, 1904-6; Superintendent, Bonanza Mine, Zacatecas, Mexico, 1906-7; Consulting Engineer, Mexico City, Mexico, 1908.

ROBERT CASIANO EATON. Leon, Guanajuato, Mexico.

Student, 1893-4. From Socorro, New Mexico. Sampling Mill Foreman, Compania Metalurgica Mexicana, San Luis Potosi, Mexico, 1894-8; Superintendent, Muriedas Smelting Works, Xichu, Guanajuato, Mexico, 1898; Superintendent, Pozo del Carmen Railroad, Compania Metalurgica Mexicana, San Luis Potosi, Mexico, 1899-1902; Manager, Nuevo Cinco Senores Mining and Milling Company, Comanja, Jalisco, Mexico, 1902-4; Independent Assayer and Ore Buyer in Leon, Gto., Mexico. since 1904.

ALEXANDER WALTER EDELEN. Bonanza, Zacatecas, Mexico.

Student, 1905-6. From Baltimore, Maryland. Assistant Superintendent, Elkton Consolidated Mining and Milling Company, Elkton, Colorado, 1906; Superintendent, Minas Bonanzas y Anexas, Zacatecas, Mexico, 1907.

THADDEUS BELL EVERHEART. Pueblo Nuevo, Durango, Mexico.

Student, 1905-7. From Bells, Texas. Assayer and Surveyor, Pere-

guina Mining and Milling Company, Guanajuato, Mexico, 1907-8; Mill Superintendent, Las Animas Mining and Milling Company, Pueblo Nuevo, Durango, Mexico, 1909.

HARRY THORWALD GOODJOHN. Torreon, Coahuila, Mexico.

Student, 1902-3. From Pittsburg, Texas. Assayer, Cia. Metalurgica del Torreon, State of Coahuila, Mexico, 1903-1906; Chief Chemist, Mapimi Smelter, 1906; Chemist and Metallurgist, Cia. Minera, Fundidora y Afinadora, Monterey, Mexico, 1907-8; Chief Chemist, Cia. Metalurgica de Torreon, Torreon, Coahuila, Mexico, 1909.

SAMUEL JAMES GORMLEY. West Jordan, Utah.

Student, 1895-6. From Mt. Vernon, Iowa. Assistant Professor of Engineering, New Mexico School of Mines, 1895-7; Assistant Assayer, Anacondá Copper Mining Company, Anaconda, Montana, 1897-1900; Chemist to same company, 1900-2; Superintendent of Sampling Works, Washoe Smelting Company, Anaconda, Montana, 1902-6; Smelter Superintendent, Bingham Copper and Gold Mining Company, West Jordan, Utah, 1906.

RUE N. HINES. Mocorito, Sinaloa, Mexico.

(B. S., New Mexico School of Mines, 1907.)

Student, 1904-7. From Socorro, New Mexico. Superintendent, West Coast Mining and Smelting Company, Mocorito, Sinaloa, Mexico, 1907.

EDMUND NORRIS HOBART. Mogollon, New Mexico.

Student, 1906-8. From Clifton, Arizona. Chemist, Socorro Mines Company, Mogollon, New Mexico, 1909.

ANTON HOGWALL. Nogal, New Mexico.

Student, 1898-9. From White Oaks, New Mexico. Assayer, Buckeye Mining Company, Water Canyon, New Mexico, 1900; Assayer, South Homestake Mining Company, and Helen Rae Mining Company, White Oaks, New Mexico, 1901; Assayer, American Gold Mining Company, Nogal, New Mexico, 1902.

CARL JOHN HOMME. Glendale, Oregon.

(A. B. St. Olaf College.)

Graduate Student, 1899-1900. From Wittenburg, Wisconsin. Assayer and Chemist to Candelaria Mining Company, El Paso, Texas, 1900-01; Assistant Superintendent, Gulf Creek Mining Company, Gulf Creek, New South Wales, Australia, 1902.

WILLIAMS ELIAS HOMME. Glendale, Oregon.

(A. B. St., Olaf College.)

Graduate Student, 1902-03. From Wittenburg, Wisconsin. Assayer, Gulf Creek Mining Company, Gulf Creek, New South Wales, Australia, 1903.

HAYNES A. HOWELL. Tehuacan, Puebla, Mexico.

Student, 1900-1905. From Socorro, N. M. Civil Engineer on railway from Acapulco, Mexico, 1906-7; Civil Engineer, Mexican Central R. R., 1907.

HARRY J. HUBBARD. Jocoro, San Salvador, Central America.

(B. S., New Mexico School of Mines, 1906.)

Student, 1905-6. From Bisbee, Arizona. Mine-foreman, Navidad Mine of Greene Gold-Silver Company, Concheno, Chihuahua, Mexico, 1906; Chemist, Navidad Mine of Greene Gold-Silver Company, 1906; Assistant Mill Superintendent, Sahuaaycan Mining Company, Sahuauycan, Chihuahua, Mexico, 1906; Machine Drill Foreman, Sirena Mine, Guanajuato, Mexico, 1907; Shift-boss, Mexico Mines, El Oro, Mexico, 1907; Examiner of mines for T. H. Whelan and Associates, in southern states of Mexico, 1907; Tramway Superinendent, Minas Bonanzas y Anexas, Bonanza, Zac., Mexico, 1908; Mine-foreman, Butters Divisavero Mines, Jocoro, San Salvador, Central America, 1909.

JOHN AUGUST HUNTER. Socorro, New Mexico.

(B. S., New Mexico School of Mines, 1903.)

Student, 1899-1903. From Socorro. Chemist, Consolidated Kansas City Smelting Company, El Paso, Texas, 1903-4; Chemist and Metallurgist, American Smelting and Refining Company, Aguas Calientes, Mexico, 1904-8.

CHARLES THAYER LINCOLN. Brooklyn, New York.

(S. B., Massachusetts Institute of Technology, 1901.)

Graduate Student, 1902-3. From Boston, Massachusetts. Chemist to American Bell Telephone Company, Boston, Massachusetts, 1901-2; Assistant in Analytical Chemistry, New Mexico School of Mines, 1902-3; Acting Professor, same, 1903-4; Instructor in Chemistry, Iowa State University, Iowa City, 1904-5; Chemist, Hartford Laboratory Company, Hartford, Connecticut, 1905-7; Chemist, Arbuckles Brothers Sugar Refinery, Brooklyn, New York, 1907.

FRANCIS CHURCH LINCOLN. Butte, Montana.

(S. B., Massachusetts Institute of Technology; E. M., New Mexico School of Mines, 1902.)

Assayer to San Bernardo Mining and Milling Company, 1900; Chemist to Butterfly Terrible Gold Mining Company, 1900-1; Professor of Metallurgy, 1902-4; Assistant Superintendent, Ruby Gold and Copper Company, Ortiz, State of Sonora, Mexico, 1904; General Manager, Arizona Gold and Copper Company, Patagonia, Arizona, 1904; Professor of Geology, Montana School of Mines, Butte, Montana, 1907.

HARRY C. MAGOON. Chicago, Illinois.

Student, 1899-1900. From Chicago, Illinois. Engineer with Illinois Steel Company, 1900.

CONRAD M. MEYER. New York, N. Y.

(A. B., New York University; M. D., Bellevue Hospital.)

Graduate Student, 1900-1. From New York City; 136 Fifth Avenue, New York City, 1901.

TARVER MONTGOMERY. Santa Ana, California.

Student, 1899-1900. From Santa Ana, California, County Surveyor, Orange County, California, 1900-1. Assistant Engineer, Temescal

Water Company, Corona, California, 1901; Transitman, San Pedro, Los Angeles, and Salt Lake Railroad Company, 1901-2; Assistant Engineer, Pacific Electric Railroad Company, Santa Ana, California, 1902.

ERLE D. MORTON. Hollywood, California.

Student, 1903-5, 1908-9. From Los Angeles, California. Assistant Superintendent, Giroux Consolidated Mines Company, Kimberly, Nevada, 1905-6; Washington University, 1906-7; Mine Examiner, Los Angeles, California, 1907-8; Surveyor, Ampara Mining Company, Etzatlan, Jalisco, Mexico, 1908.

WILLIAM FREDERICK MURRAY. Denver, Colorado.

Student, 1904-6. From Raton, New Mexico. In Chief Engineer's Office of the Victor Fuel Company, Denver, 1906-7; Assistant Engineer, Victor Fuel Company, 1907-8; Assistant to Chief and Traveling Engineer, Victor Fuel Company, and Colorado and South-Eastern Railway Company, 1908.

PATRICK J. O'CARROL.*

(B. A., University of Dublin, Ireland.)

Graduate Student, 1898-9. From Dublin, Ireland. Mine Operator, Gallup, New Mexico, 1899-1901.

ALVIN OFFEN.*

Student, 1895-6. From Butte, Montana. E. M., 1896; Assistant Superintendent, Philadelphia Mine, Butte, Montana, 1896-7.

JUAN PALISSO. Mexico.

Student, 1903-4. From Barcelona, Spain. Mining Engineer, Mexico.

ORESTE PERAGALLO. El Paso, Texas.

(E. M., New Mexico School of Mines, 1908.)

Student, 1907-8. From Ciudad Juarez, Chihuahua, Mexico. Mining Engineer, El Paso, Texas, 1908.

FOUNT RAY. Italy, Texas.

Student, 1901-2. From Waxahachie, Texas. General Manager, Lena Mining and Concentrating Company, Lordsburg, New Mexico, 1902; Cashier, Citizens National Bank, Italy, Texas, 1902.

ALBERT BRONSON RICHMOND. Safford, Arizona.

Student, 1900-1. From Las Prietas, Sonora, Mexico. Superintendent, Ramona Mill Company, Gairlon, Sonora, Mexico, 1901-2; Assayer, Patagonia Sampling Works, Patagonia, Arizona, 1902; Assayer and Metallurgist, Patagonia, Arizona; at present, General Manager, Mansfield Mining and Smelting Company, Safford, Arizona.

DELL FRANK RIDDELL. Parral, Mexico.

(Ph. C., Chicago College of Pharmacy, 1896; B. S., Nebraska State University, 1901; M. E., New Mexico School of Mines, 1905.)

Graduate Student, 1903-5. From Sioux Falls, South Dakota. Pro-

* Deceased.

fessor of Chemistry, Sioux Falls College, 1901-3; Instructor in Chemistry, New Mexico School of Mines, 1903-4; Acting Professor of Assaying, same, 1904-5; Holder of Allis-Chalmers Scholarship, 1905-6; Engineer Universam Pump and Manufacturing Company, Kansas City, Missouri, 1906-7; Superintendent, Benito Juarez Mine, Parral, Chihuahua, Mexico, 1907-8; Consulting Engineer and acting Superintendent, Providentia Mines Company, Parral, Chihuahua, Mexico, 1908.

WILLIAM CARLOS STEVENSON.* Redlands, California.

Student, 1900-1. From Hillsboro, Ohio. General Manager, Mining Corporation, Albuquerque, New Mexico, 1901.

JOHN STUPPE. Torreon, Coahuila, Mexico.

Student, 1903-4. From El Paso, Texas. Accounting Department, El Paso Smelting Works, El Paso, Texas, 1896-1902; Metallurgical Department, Compania Metalurgica de Torreon, Torreon, Coahuila, Mexico, 1902.

LEO RICHARD AUGUST SUPPAN. St. Louis, Missouri.

(B. S., in Chemistry and Metallurgy, New Mexico School of Mines, 1896.)

Student, 1895-6. From St. Louis, Missouri. Instructor in Chemistry, New Mexico School of Mines, 1895-7; Graduate Student, Johns Hopkins University, 1897-8; Professor of Chemistry, Marine-Sims College of Medicine, St. Louis, 1898.

CHARLES L. SEARCY. Monterey, Mexico.

Student, 1903-4. From Peoria, Illinois. Mining Engineer, Monterey, Mexico.

CHARLES H. SHAMEL. Bellingham, Washington.

(B. S., M. S., University of Illinois; LL. B., University of Michigan; A. M., Ph. D., Columbia University.)

Graduate Student, 1901-2. Mining Lawyer, Bellingham, Washington.

OLIVER RUSSELL SMITH. Zillah, Washington.

(B. S., Kansas College of Agriculture and Mechanic Arts, 1898; C. E., New Mexico School of Mines, 1903.)

Graduate Student, 1899-1901. From Manhattan, Kansas. B. S., in Civil Engineering, New Mexico School of Mines, 1901; Assistant in Mathematics and Draughting, New Mexico School of Mines, 1900-1; Instructor in Engineering and Drawing, New Mexico School of Mines, 1901-2. Assistant Professor in Engineering and Drawing, New Mexico School of Mines, 1902; Assistant Surveyor, U. S. Land Office, 1902; City Engineer of Socorro, New Mexico, 1902; Deputy Mineral Surveyor, U. S. Land Office, 1903; Professor of Civil Engineering, New Mexico School of Mines, 1902-7; Civil Engineer, Santa Fe R. R., San Bernardino, California, 1907-8; Engineer, United States Reclamation Service, Zillah, Washington, 1908.

OTTO JOSEPH TUSCHKA. Monterey, Mexico.

(E. M., in Metallurgy, New Mexico School of Mines, 1897.)

Student, 1893-7. Assayer and Chemist, Graphic Smelting Works,

Magdalena, New Mexico, 1897-8; Graduate Student, New Mexico School of Mines, 1898-9; Assistant Sampling Mill Foreman and Chemist, Guggenheim Smelting and Refining Company, Monterey and Aguas Calientes, Mexico, 1899-1900; Assayer, Seaman Assay Laboratory, El Paso, Texas, 1900; Chief Chemist, Compania Minera Fundidora y Afinadora "Monterey," Monterey, Mexico, since 1900.

MILTON BENHAM WESTCOTT. Monterey, Mexico.

Student, 1904-5. From Chicago. Engineering Corps, Santa Fe Railroad, 1905; Assistant County Surveyor, El Paso County, 1906-7; Assistant Engineer, Monterey Railway, Light and Power Company, Monterey, Mexico, 1907; Assistant Engineer, Monterey Waterworks and Sewer Company, 1907-8; Resident Engineer, Monterey Water Works and Sewer Company, 1908.

PATRICK ANDREW WICKHAM. Ray, Arizona.

Student, 1893-4. From Socorro, New Mexico. Assistant, Rio Grande Smelting Works, Socorro, New Mexico; Mechanical Engineer, Buckeye Mining Company, and Albemarle Mining Company, Bland, New Mexico, 1898-9; Mechinical Engineer, Mt. Beauty Mining Company, Cripple Creek, Colorado, 1899-1900; Engineer, Empire State Mining Company, Cripple Creek, Colorado, 1900-1; Engineer, Guggenheim Exploration Company, Minas Tecolotes, Santa Barbara, Mexico, 1901-2; Resident Engineer, Independence Consolidated Mining Company, Independence, Colorado, 1902-4; Manager, Minas Dolores, Mexico, 1904-6; Assistant Superintendent, Kelvin-Calumet Copper Mining Company, Ray, Arizona, 1907.

WAKELEY A. WILLIAMS. Grand Forks, British Columbia, Canada.

Student, 1893-4. From Council Bluffs, Iowa. Assistant Superintendent and Metallurgist, Granby Consolidated Mining, Smelting and Power Company, Limited, Grand Forks, B. C., 1898; at present, Superintendent of the same.

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